PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

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Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

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The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

A CRITICISM OF MR. GIBSON'S ARTICLES ON ASPHALT.

To the Editor of Paving and Municipal Engineering:

DEAR SIR:—Frequently before has your special representative in Europe, Mr. Louis H. Gibson, displayed his ignorance regarding asphalt street pavements, but never so much as in last letter, published in your December number, in which he caps the climax.

If Mr. Gibson was instructed to write up the asphalt pavements in the interest of the Paris—or rock—asphalt contractors, regardless of truth, he certainly fulfills his mission, but if his instructions are to report his observations regarding asphalt pavements in European cities for the information and enlightenment of the citizens of the United States, and in the interest of good asphalt pavements for the cities of this country, he fails conspicuously. Mr. Gibson shows that he does not know what asphalt really is, and is therefore easily misled by the "noted French writer on asphalt," who, if it is not Mr. DeLano himself, was certainly inspired by that gentlemen.

The bituminous limestone, which is used for laying asphalt-street pavement in European cities, is not asphalt but a limestone or limerock, impregnated with asphalt or bitumen. Any encyclopædia gives that information. There can be found: "Asphalt or asphaltum, the German bergpech, or mineral pitols, so called from the Larus asphaltities or Dead Sea, where it was found in ancient times, is a product of the decomposition of vegetable and animal substances," and further on: "Of greater importance industrially than simple asphalt is the asphalt-stone, a limestone impregnated with bituminous matter, which occurs in large quantities in several European localities." It is true that Mr. Bardbant, Malo and other French writers on asphalt, call this asphaltic limestone asphalt, but that does not justify the calling of the American asphalt "imitation," nor the ridiculous criticism of the American asphalt pavements which have been successfully laid in the United States for more than fifteen years. In fact 99¾ per cent. of all the millions of square yards of asphalt pavements laid in the United States are composed of an artificial mixture with refined Trinidad asphalt, and the term "imitations" only serves to mislead the public.

The facts are, in the fall of 1886 the Barber Asphalt Paving Company laid two sections of Rue de Rivoli in Paris, both together containing about 8,000 square yards, with asphalt, the same mixture as that company had successfully laid by the million yards in the United States. The company had felt too confident of their ability to lay a durable pavement for very heavy traffic, and had requested the Paris authorities to give them portions of the most heavy traffic streets. The request was granted, and the company received two sections on Rue de Rivoli, one between Rue Clorhe Peroe and Rue Labaw, the other between Rue du Pont Neuf and Rue du Louvre, embracing the part on which M. Leon Malo, in his pamphlet, "Les Voies Asphaltics de Berlin," 1885, claims that 42,000 horses pass in twenty-four hours.

Mr. De Lano, the Paris asphalt contractor, had absolutely refused to pave these sections with his rock asphalt, consequently the manufacturers of natural asphalt (I never heard of such manufacturers) were not injured. The composition of the American asphalt was well known to the French engineers, and favorable reports had been sent from the engineers of the French legation at Washington, D. C., to Paris. M. Barabant, engingeer en chef, calls it, in his report of 1883, "L'asphalte de Smedt," and gives, on page 66, a complete statement of the composition.

The presence of street-car tracks (which are always detrimental to asphalt pavements) in the sections laid, the laying of asphalt joining the rails as desired by the authorities of Paris, the numerous rainfalls during the periods of laying, between October 14th and November 4th, and between November 23d and December 16th all combined and helped to make the undertaking a failure. In addition to these, and more than all the rest, the peculiar and enormously heavy traffic which is more than four times as much as on any point of Broadway, New York, brought about the rapid de-

destruction of the pavement. The peculiarity of the traffic on Rue de Rivoli in Paris, is that all wagons, loaded or unloaded, go on a trot. Every four minutes an omnibus wagon passes, going on a trot, weighing loaded seven tons, drawn by three heavy Normandy horses. No wonder that a failure was a result, but it was due to over-confidence and not due to an attempt to make money by using a cheap, unreliable article. The loss was borne by the American company, every cent of it and not by the city. There was no unnecessary display of darkies, nor an ostentatious use of an illuminated steam-roller, but an earnest, honest effort to succeed, and any attempt to ridicule or belittle such an effort deserves contempt, especially when it comes from an American. The article on "American asphalt counterfeit by a noted French writer," is a willful, slanderous misrepresentation of facts, coupled with astonishing ignorance about asphalt. That the same mixture as was laid in Paris, if well prepared with carefully selected materials, will stand a comparatively heavy traffic has been proven in numerous American cities. Failures are almost always due to careless preparations in the use of Trinidad asphalt, as well as in the use of rock asphalt. The different stratas of the rock asphalt or bituminous lime-rock differ in some localities greatly in the percentum of bitumen, and only by a careful mixing of the richer with the poorer stratas, a reliable mixture can be obtained.

The Trinidad asphalt pavements, when well laid, compare very favorably with the rock asphalt pavements, and have the advantage of being less slippery. Any one wishing to make observations can see failures in rock-asphalt pavements, at almost any time in Berlin, Paris or London—in Berlin more frequently, because, all different localities, where asphaltic limerock is found, are represented, also because it has more rock-asphalt pavements than Paris and London together. The United States have about eight times the number of square yards of asphalt pavements as are laid in all of the European cities, and consequently it is rather late to call that pavement "a counterfeit."

I am neither directly nor indirectly connected with the Barber Asphalt Paving Company, nor have I been asked to defend that company, but I am well acquainted with all the circumstances, and therefore have written these lines only in the interest of truth, and the furtherance of the American asphalt pavements, which they deserve.

I hope you will give these lines as widespread a circulation as you gave to Mr. Gibson's letter, and thereby help the cause of the best, cheapest in time, and for the health most beneficial pavement.

Yours very truly, JULIUS SCHUBERT.

New York, January 5, 1892.

MR. GIBSON'S REPLY.

MY motive in writing about asphalt was to determine the causes of the good results from the use of that material in Europe. I understood that the United States Government had directed one or more of its foreign representatives to make inquiries and to specifically determine the cause of the success in the use of the foreign material. If I show my ignorance in writing about that material it would be to the point and in the interest of justice to all asphalt paving companies that my errors be clearly and specifically pointed out. I have no other interest in the matter than the general good of our cities that are struggling, sincerely, to secure a high grade paving material. It is manifest to me that the coverings with the material called asphalt by Mr. Schubert and the paving companies of America is not as generally satisfactory as those used in Europe. It is certainly true that the proportion of good asphalt paving in America is much less than that of foreign countries where the reputation of that material was made.

Mr. Schubert says that I do not know what asphalt really is. The Encyclopedia of Construction, modern; Colonel Heywood, engineer in chief of the city of London in 1870; Leon Malo, of Paris; Richard Kruger, of Berlin, engineer, and author of "Handbook of General Street Building in Cities," as well as many other principal engineers of Europe, define asphalt as set forth in my articles. It is from them, as well as from observation and examination, that I have drawn my information. My authorities are at hand. The question of right in this matter is, therefore, not between Mr. Schubert and myself, but rather between Mr. Schubert and the principal engineers of Europe. This point must be clearly understood—that the asphalt of Europe is not the asphalt of America. One is asphalt and the other is not. Mr. Schubert says: 99¾ per cent. laid in the United States "is an artificial mixture," which is stating my point in a stronger form than I have ever done. All that I have claimed is that European asphalt is the powdered asphalt rock, heated and applied without the admixture of other material, while the American article is a mixture—a fabrication. Mr. Schubert confirms this statement more fully than I have been able to. He has the statistics with respect to the use of the fabricated material which I did not have. I admit myself surprised that so large a proportion as 99¾ per cent. of the "asphalt" covering laid in America is "an artificial mixture." This is an overwhelming demonstration of the fact that there is no paving material used in America such as is known as asphalt in Europe.

Either the material used in America or that used in Europe is not asphalt. They are entirely different materials. One is a natural, unadulterated product, and the other, according to Mr. Schubert, is "an artificial mixture." It is a question of the use of the word asphalt, the two materials being radically different, and the same name being used. The question resolves itself into one of priority in the use of the term. I leave it to Mr. Schubert as to whether the engineers of America, or those of Europe, are entitled to the use of the term.

As I understand it, the first asphalt street was laid in Paris in 1838, though the history of the material goes well back of that. This pavement was of powdered asphalt rock from the mines of Seyssel. I am criticised for using the word "counterfeit" in connection with a material bearing the same name as these first streets, a material which Mr. Schubert admits is "an artificial mixture." It is possible that it would have been more graceful to have used the term "fabrication" or "imitation." But to put an end to all this, I do not care to quibble over terms. The fact is, the two materials are different and bear the same name.

In order that there may be no misunderstanding, and to show that there is no disagreement between Mr. Schubert's letter and the facts with respect to the Rue de Rivoli incident, I give a translation from Leon Malo's work on asphalt. It may be said that Leon Malo is prejudiced because he is the engineer of the mines at Seyssel. Yet Mr. Richard Kruger, the German engineer, in his hand-book on street constructions, confirms all that is said by Leon Malo with respect to asphalt in general, and goes farther than the latter by saying that the asphalt from the mines of Val de Travers and Seyssel is the best found in the world. Furthermore, the matter in the Enclopedia Construction Modern quotes Leon Malo as its authority on asphalt. After this there can be no reasonable accusation:

"In the month of September an American asked permission from the city of Paris to lay on Rue de Rivoli, upon one of the most traveled sections, a specimen of bituminous pavement of his own invention, which, because of its resistance and cheapness, was destined to supplant the asphalt pavements of Europe. Although made very prudent by the circumstances which we have previously recounted, the city could not refuse to acceed to a proposition which presented such perfect security to its budget. Also, the inventor affirmed and proved by the certificates from several Americans, that more than a million square meters of his system of pavement existed in the cities of the United States, New York excepted, and that the effect of them was marvelous.

"A surface of 7,000 meters was given him between the Louvre and Rue du Temple. During three months, from September to the first of December, the passage of vehicles was intercepted. Negroes sent from America executed the work with a slowness of 'Bon Augure;' a little steam roller, illuminated like an image of Epinal, moved incessantly over the bituminous surface in a manner to compress it with considerable engery. The street was opened the fifth of November. The ninth of November, or three days afterwards, unexpected holes manifested themselves beside

the street car rails. They continued to appear constantly afterwards. They were filled with bitumen and afterwards with gravel, but nothing succeeded. The entire surface gave under the wheels of the vehicles. The twenty-fourth of June the inventor received an order to remove, as quickly as possible, what remained of his invention."

From this any one can see that there is no essential difference between Mr. Schubert's statement and that of Leon Malo, with respect to the Rue de Rivoli incident. The pavement failed because "the company felt too confident of their ability to lay a durable pavement for heavy traffic." Farther on, he says: "The presence of street car tracks" and "the peculiar and enormously heavy traffic" caused the failure. Does Mr. Schubert mean to say that the pavement to which he refers is not suitable to be used next to, or between street car tracks? That it will not stand the heavy traffic to which he refers, and can not be successfully used under these conditions? Does he mean to state that the "artificial mixture" is not suited for such service?

LOUIS H. GIBSON.

SPECIFICATIONS FOR BRIDGES.

THE letting of contracts for construction of bridges is one of the most important duties to be performed by county commissioners, as the securing of the best bridge for the money expended is an item of no small economy, and the construction of a bridge that will accommodate the present and future traffic of a road or turnpike without danger to the lives of the public a duty unquestioned.

Under the practice in vogue in many counties and cities to-day neither of the above results are accomplished. At present, in many cases, the commissioners advertise for a bridge, and proposals received on data supplied by each individual bidder, each striving to have his proposal accepted, and often making claims and representations in regard to his bridge unwarranted by the dimensions of the structure presented; the commissioners, acting as they think for the best, accept a proposal, not that they *know* that the bridge is up to the requirements, but simply because the agent says it is, and to escape the pulling and button-holing of the rival agents. The accepted bridge is built and soon falls under an ordinary load, injuring or killing whoever may have been on it at the time of its fall. The county then is called upon and pays the damage either on compromise or at the end of tedious and expensive litigation. The company whose bridge fell, when reminded of the fact, replies: "Oh! well, we built the bridge exactly according to our contract, and strictly according to the specifications; if any one is at fault, the commissioners who built the bridge are the ones to blame," so fixing the responsibility exactly where it lies.

To secure competition on a bridge, specifications should be adopted and adhered to. These specifications should contain nothing that inures to the benefit of any one competitor, should specify the minimum load to be carried and both the amount of strain and maximum per square inch permissible on every member, and data for the details of proper construction, that all competitors shall be on the same basis. Any design submitted under such specifications will vary only in the less important items such as hand rail (if none is specified), portal struts and brackets, bret guards and ornamentation, and in these things allowing ample room for the designer to secure the most pleasing effect and most economical construction. The strength, however, should be the paramount object sought. After proposals are received the work should be awarded the lowest bidder if he can comply with the law, and a contract drawn embodying the specifications as adopted by the board—not those submitted by the company—as a part thereof, and before any work is done, the company's plans should be examined by a competent engineer acting for the board, and be marked approved by him. After the erection he should carefully examine all parts of the bridge and be satisfied that the requirements of the specifications are faithfully carried out. The greatest publicity should be given of the intentions to build the bridge and this can be done by advertising in PAVING AND MUNICIPAL ENGINEERING. We reproduce specimen specification for such work prepared by M. M. Defrees, civil engineer, of Indianapolis, and recommend the same to county commissioners and engineers as containing all the safeguards for for securing a good bridge.

SPECIFICATIONS FOR A WROUGHT-IRON BRIDGE.

To be erected by the commissioners of——county, state of——over——in said county.

Length.—1. The bridge will consist of——spans of——and——spans of——center to center of end pins, with——roadway——each——feet clear, and——sidewalks, each——clear. The roadway shall have at least——feet clear head-room.

Type.—2. The form of truss may be selected by contractor, when form is not otherwise provided for. Limit number of panels to——.

Portals.—3. Ends of through bridges will be provided with portal struts of neat design.

Diagonal Bracing.—4. When truss has sufficient depth, overhead diagonal bracing shall be provided, but no reduction for length in post shall be figured.

Angle.—5. Axis of bridge will make an angle of——degrees with face line of masonry.

6. All parts of bridge shall be accessible for painting.

Name Plates.—7. Plates giving name of contractor and year of erection and name plate of commissioners shall be on all bridges.

Unit Stresses.

Unit Strains.—8. The maximum strain on members, whether of iron or steel, shall not exceed the following:

On bottom chords and main diagonals, dead load, 12,500 pounds per square inch.

On bottom chords and main diagonals, live load, 10,000 pounds per square inch.

On counter and vertical ties diagonals, 9,000 pounds per square inch.

On beam hangers, 6,000 pounds per square inch.

On lateral rods, 16,000 pounds per square inch.

On pins, bending moment, outer fiber, 15,000 pounds per square inch.

On top flange floor beams and stringers, 10,000 pounds per square inch.

On bottom flange floor beams and stringers, 10,000 pounds per square inch, net section.

On timber, joist, or beams, 1,200 pounds per square inch.

On rivets and pins, shearing, 8,000 pounds per square inch.

On all bearings, 12,000 pounds per square inch.

On compression members,

$$\frac{1}{4}\left\{42{,}500-\frac{l}{r}\right. \text{—160 for 2 pin ends.}$$

$$\frac{1}{4}\left\{42{,}500-\frac{l}{r}\right. \text{—130 for square ends.}$$

$$\frac{1}{4}\left\{42{,}500-\frac{l}{r}\right. \text{—145 for 1 pin and 1 square.}$$

Where l, length in inches, and r, radius of gyration. End and intermediate posts will be considered as having 2 pin ends. End panels of top chord as one pin, one square, intermediate top chord panels as 2 square ends.

Alternate Strains.—9. Members subjected to alternate strains will be provided with material sufficient to satisfy both kinds of strain.

Combined Strains.—10. Members subjected to bending moment in addition to tension or compression will be proportioned accordingly.

Pin Holes.—11. Pin holes will be bored in center of gravity of chords and post.

Cross Section Preferred.—12. Preference will be given sections having center of gravity co-incident with center line of members.

Loads.

Wooden Floor.—13. The floor will consist of 2½ inch plank resting on oak joist spaced not more than 18 inches center to center.

Floor plank will be spiked to joist with barbed wire spike 7 inches long, driven through each plank into each joist.

Metal Joist.—14. If iron or steel joist are used they shall not be spaced farther apart than 30 inches center to center and the thickness of the floor plank increased to 4 inches.

Load on Floor System.—15. The floor system shall be proportioned to carry——pounds per square foot of floor, and its own weight at 4 pounds per foot, B. M. Should the——pounds per square foot not exceed the maximum strain of a traction engine, with a wheel base of 5 feet, guage 5 feet, with 4,000 pounds on front and 10,000 pounds on rear wheels, then the latter strain is to be used.

Felloe Plank.—16. Felloe plank will be at least 4x6 in. pine or oak.

Hub Guards.—17. Hub guards as per contractors' design.

Hand-Railing.—18. Sidewalk hand-railing of———pattern.

Beams, How Calculated.—19. Floor beams, stringers or girders will be calculated for that position of load giving maximum strains, and in their calculation use moment of inertia of section, omitting inertia of web.

Load on Walks.—20. Sidewalks will carry a load of ——pounds per square foot in addition to their own weight.

Load on Trusses.—21. Trusses will be proportioned, under limits above, to carry a load of——pounds per square foot of floor moving on bridge, in addition to their own weight, the weight of floor, beams, railings, guards, and laterals. For weight of iron to assume calculations use table on last page.

Wind Strain.—22. Lateral system shall be proportioned for a force of 30 pounds per square foot of exposed surfaces of bridge, as shown in elevation, considered as a moving load, and in addition a strain of 10,000 pounds on each member, due to adjusting tension members.

Construction.

Limit of Rods.—23. No rod less than $\frac{3}{4}$ square inch in section shall be used.

Upset Ends.—24. All rods and hangers with screw connection must have upset ends, and be without weld in their whole length.

Strains From Adjustment.—25. All rods subject to adjustment shall be proportioned to resist a strain of 10,000 pounds, in addition to strain from loads.

Limit in Plates.—26. No plate under stress shall be less than $\frac{1}{4}$ inch thick, no angle iron with less than $\frac{1}{4}$ inch thickness shall carry strain.

Splice Plates.—27. Re-enforcing and splice plates must be provided with a sufficient number of rivets to tranfer strains.

Braces for Pony Trusses.—28. Pony or half-deck bridges will be provided with braces at each panel point extending from top chord to floor beam.

Roller Ends.—29. Trusses over 80 feet span will be provided with wrought iron rollers at one end not less than 2 inches diameter, and working on planed surfaces, and have a pressure per lineal each of roller of not more than $700\sqrt{d}$, d being diameter of roller.

Securing Ends.—30. Both ends of trusses to be secured to masonry in such manner as not to interfere with action of rollers or sliding plates.

Sliding Plates.—31. Trusses under 80 feet span shall be provided with sliding plates under one end secured to masonry.

Temperature.—32. A variation in temperature of 150 degrees shall be provided for.

Bed Plates.—33. Bed plates shall not be less in thickness, after planing, than 5-8 inch for spans up to 80 feet, over 80 feet spans, plates 3-4 inch thick after planing.

Load on Bed Plates.—34. All bed plates shall be proportioned so as not to bring more than 200 pounds per square inch onto the masonry.

Lead Bearing.—35. Under all bed plates sheet lead 3-16 inch in thickness shall be placed.

Eye Bars.—36. Eye bars shall be without weld in any portion of length, and eyes formed so that bar will break under rupturing strain in the body of the bar and not in the head or enlarged portion of bar.

Loop Eyes.—37. Loop eyes on bars will be formed to fit perfectly around semi-circumference of pin.

Boring Pin Holes.—38. Pin holes will be bored in center line of bars and shall not exceed turned diameter of pin more than 1-100 inch.

Packing.—39. All bars shall be packed as closely as possible, and all spaces between bars filled with wrought iron packing rings.

Tie Plates.—40. The open sides of all compression members of trough-shaped sections shall be stayed with tie plates at the ends and latticing or lacing bars at intermediate points; the length of the tie plates will be determined by

$$l = .5D + \frac{d}{D} + 1.5.$$ where lattice bars are used.

$$l = D + \frac{2d}{D} + 2.$$ where lacing bars are used.

Where **l**, length, **D** depth of section, and **d**, distance between inner faces of section.

Spacing Lacing Bars.—41. The distance between points of attachment of lacing bars will be determined by $l = \frac{Lr6}{R10}$. Where **R**, least radius of gyration of whole section, and **r**, least radius of gyration of individual member, **L**, length of column in inches. If **l** should come out equal to or less than "**d**" use lacing bars with distance "**d**" between points of attachment. If **l** comes out greater than **d**, use lattice bars and space **l**=4-3**d**. But bars shall not make more than 60° with each other or less than 60° with flanges.

Size of Lacing Bars.—42. The size of diagonal lacing bars shall be as follows:

For Channels of depth	4 to 6	inches,	bars	$1\frac{1}{2}$	in. x $\frac{1}{4}$ in.
" "	6 to 8	"	"	$1\frac{3}{4}$	in. x 5-16 in.
" "	9 to 11	"	"	2	in. x $\frac{3}{8}$ in.
" "	12 to 14	"	"	$2\frac{1}{2}$	in. x $\frac{3}{8}$ in.
" "	15 to 18	"	"	3	in. x $\frac{3}{8}$ in.
" "	19 to 24	"	"	3	in. x 7-16. in.

Stiffeners.—43. All beams, stringers or girders will have stiffeners introduced when the shearing force on the web exceeds $1 + \frac{\frac{8{,}000}{d^2}}{3{,}000\,t^2}$ Where **t**=thickness of web, and **d**= depth of web.

Spacing Stiffeners.—44. Stiffeners will not be spaced farther apart than the effective depth of the section. Stiffeners will carry the shearing strain in question, allowing 10,000 pounds per square inch in section.

Bearing Stiffeners.—45. All web plates will have stiffeners at both edges of bearing plates.

Pitch of Rivets.—46. The pitch of rivets shall not exceed 6 inches, nor be less than three diameters of rivet. At ends of compression members the pitch shall not exceed 4 diameters of rivet for a length of twice the depth of the member. The distance from center of rivet to edge of plate shall not exceed 8 times the thickness of the plate, nor be less than $1\frac{1}{2}$ times the diameter of rivet.

Field Rivet Holes.—47. All holes for field rivets shall be reamed when the parts are temporarily put together, or drilled from accurately prepared templates before assembling.

Bolts.—48. Where bolts are used instead of rivets, the holes shall be drilled or reamed, and the bolt turned to driving fit, the head and nut faced.

Camber.—49. Camber will be given the trusses by making panel lengths of top chord longer than those of bottom chord in the proportion of $\frac{1}{4}$ inch in every 12 feet.

Material.

Material.—50. All material and workmanship excepting as conflicting with anything herein shall be according to "Standard Specifications Adopted by Bridge Builders."

Test Reports.—51. The contractor, will, if required, furnish to the engineer in charge of the work, copies of tests on all material entering into the construction of the bridge, such tests having been

made by some well known and equipped professional inspector or inspectors.

Paint.—52. The work after erection shall receive two coats of paint of any color acceptable to the engineer in charge.

Strain Sheets and Drawings.—53. Contractor will, if required, furnish to engineer in charge, complete copies of all strain sheets and working drawings in duplicate, and he shall not begin work of construction until one approved copy has been returned to him, but such approval will not relieve the contractor from the expense that may, through oversight, escape the notice of the engineer. The county shall be held blameless for such error.

Old Structure.—54. If the new bridge replaces an old one, the contractor will, if required, remove old bridge and pile material convenient for loading.

Damages.—55. Contractor will be responsible for all damage resulting to bridge from floods or other causes, and also for all injury to workmen or others during erection.

Partial Estimates.—56. The payment of money to contractor at any time before the final acceptance of the work shall not in any any manner be considered as an acceptance of any portion of the work.

Work Accepted.—57. The work will be considered as accepted only when order for final payment is made by commissioners.

Differences; How Settled.—58. Any dispute between the contractor and commissioners, or their representative, regarding the requirements of these specifications shall be referred to the author, whose decision shall be final and binding on both parties.

Weight of Iron.—The following table gives the number of pounds of load one pound of iron will sustain per linear foot of truss, "Factor 4" in Highway Bridges, roadway 14 feet. For other "Factors" and widths of roadway add proper proportional amount—tension 12,500. Comp.—Gordon x ¼.

SPAN FEET.	LOW TRUSS. NUMBER PANELS.				HIGH TRUSS. NUMBER PANELS.							
	2	3	4	5	3	4	5	6	7	8	9	10
30	15.0	13.4	.....	.....	11.2	.....	.....	.....	.....	.....	.....	.....
35	15.7	13.2	.....	.....	11.0	.....	.....	.....	.....	.....	.....	.....
40	16.4	13.0	12.0	.....	10.8	10.4	.....	.....	.....	.....	.....	.....
45	.....	12.8	11.6	.....	10.7	10.3	.....	.....	.....	.....	.....	.....
50	.....	12.4	11.2	9.4	10.6	10.2	9.3	.....	.....	.....	.....	.....
55	.....	11.7	10.8	9.3	10.5	10.1	9.2	.....	.....	.....	.....	.....
60	.....	11.3	10.4	9.2	10.4	10.0	9.1	.....	.....	.....	.....	.....
65	.....	.....	10.0	9.1	.....	9.8	9.0	9.0	.....	.....	.....	.....
70	.....	.....	9.6	9.0	.....	9.7	8.9	8.8	9.0	7.8	.....	.....
75	.....	.....	9.4	8.7	.....	9.6	8.9	8.7	8.8	7.7	.....	.....
80	.....	.....	9.3	8.6	.....	9.5	8.8	8.6	8.6	7.6	.....	.....
85	.....	.....	9.0	8.4	.....	9.4	8.6	8.5	8.4	7.5	.....	.....
90	.....	.....	.....	8.2	.....	.....	8.5	8.4	8.2	7.4	6.9	.....
95	.....	.....	.....	8.0	.....	.....	8.4	8.3	8.0	7.3	6.8	.....
100	.....	.....	.....	7.6	.....	.....	8.3	8.3	7.8	7.2	6.7	6.5
105	.....	.....	.....	7.2	.....	.....	.....	8.2	7.6	7.1	6.6	6.4
110	.....	.....	.....	.....	.....	.....	.....	8.0	7.4	7.9	6.5	6.3
115	.....	.....	.....	.....	.....	.....	.....	7.9	7.2	6.9	6.4	6.2
120	.....	.....	.....	.....	.....	.....	.....	7.6	7.1	6.8	6.3	6.1
125	.....	.....	.....	.....	.....	.....	.....	7.4	7.0	6.7	6.2	6.0
130	.....	.....	.....	.....	.....	.....	.....	7.0	6.8	6.5	6.1	5.9
135	.....	.....	.....	.....	.....	.....	.....	.....	6.6	6.4	6.0	5.8
140	.....	.....	.....	.....	.....	.....	.....	.....	6.5	6.3	5.9	5.7
145	.....	.....	.....	.....	.....	.....	.....	.....	6.3	6.2	5.8	5.6
150	.....	.....	.....	.....	.....	.....	.....	.....	6.0	6.0	5.7	5.5
155	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.8	5.5	5.5
160	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.6	5.3	5.4
165	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.4	5.2	5.3
170	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.2	5.1	5.1
175	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.0	5.0
180	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.9	4.8
185	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.8	4.7
190	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.7	4.6
195	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.5
200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.3

EXAMPLE: Whad dead load shall be assumed in an 8-panel 120-foot span iron bridge, 14-foot roadway, 2½-inch plank floor, 10 lines of 3x12 inch joist: Live load, 100 pounds per square foot. Live load per linear foot=1400 pounds. From Tables 1 and 2: Dead load of floor 140 pounds and joist 120 pounds, or a total of 1660 pounds. 1660 divided by 6.8 (see Table 3)=244; 244 divided by 6.8=36; 36 divided by 6.8=5. 244 plus 36 plus 5=285. 260 (weight of timber) plus 285 (weight of iron)=545, total dead load, to assume in calculations.

GOOD AND BAD ROADS.

By Isaac B. Potter.

LAST March the farmers of Chester county, Pennsylvania, were using a six-horse team to draw a single load of hay. On the 21st day of that month one of the "leaders" in that team stumbled and fell in the deep mud and water which covered the road and was drowned before he could be got out. In Montgomery county, Maryland, during the same month, a lady recovered $2,500 damages from the county for personal injuries received by reason of the bad roads. Costs and disbursements swelled the sum to about $4,000. But these are only incidents, and they have no force except as illustrations. The real unmitigated iniquity of a mud road must be seen by a more extended view.

Let us try a few statistics. You hate statistics and so do I. Take them as they go, and they are drier than a mouthful of dust, and we both know what that is. But once in a while the Government sends a man round to count things, just to see whether we are all here and how we are all getting on, very much in the same way that we count eggs and chickens and measure rye and oats. We are dealing with a big subject and one which concerns all the people. Let us look at it from a stand-point, where everybody can see the inspiring spectacle. I want you to understand, if you do not see it already, that a bad road is really the most expensive thing in your agricultural outfit; that it is as much behind the times as the hand-loom and the flail and sickle; that it has no rightful place in the domain of an intelligent people.

From official government sources I find that the farmers of this country, in the year 1890, had upon their farms draft animals as follows:

	Number.	Value.	Average Price.
Horses	14,213,837	$978,516,562	$68.00
Mules	2,331,027	182,394,099	78.00
Oxen, etc	36,849,024	560,625,137	15.00
Total	53,393,888	$1,721,535,798	

Now to simplify matters a little, you see you have nearly $2,000,000,000 invested in motive power of a perishable, uncertain and expensive kind. Busy or idle, these animals must be fed and cared for every day. They are boarders that you can't get rid of when the busy season is over and it stands you in hand to keep them at work. Two thousand millions of dollars make a large sum. Invested at 5 per cent. interest it would produce nearly $2,000,000 per week. Then you see there are more than sixteen millions of horses and mules alone, and to feed and care for these it costs the modest sum of $4,000,000 per day. A little while ago a very clever and intelligent citizenof Indiana estimated that bad roads costs the farmer $15 per year for each horse and mule in his service. This means a loss in the aggregate of nearly $250,000,000 per year. Add wear and tear of wagons and harnesses, $100,000,000; depreciated value of farm lands, $2,000,000,000; total, *twenty-three hundred and fifty millions of dollars.*

Making the utmost allowance in favor of the farmer and granting the necessity for the liberal use of horse-power in the maintenance of agricultural traffic, it is easily certain that the farmers of this country are keeping at least two millions of horses more than would be necessary to do all the hauling between farm and market if only the principal roads were brought to a good condition. If you assume that each of these horses is fed the ordinary army ration of hay and oats, it requires 14,000 tons of hay or fodder and 750,000

bushels of oats per day to feed these unnecessary animals, which themselves have a money value of $140,000,000. The value of hay and oats fed to these horses per day is about $300,000, or something like $114,000,000 per year. This computation is made by estimating the value of hay at $10 per ton, and oats at twenty-three cents per bushel, these figures being close to the average value in the several states during the year 1889.

PROGRESSIVE STEPS IN IMPROVING PUBLIC HIGHWAYS AND STREETS.

By John Beers, C. E.

IN all ages of the world's history among the more enlightened races of people, the improvement of the various highways of travel has afforded an important theme for discussion, a great field for experiment and an opportunity for the expenditure of vast sums of money, the public necessity for which has also given rise to a multitudinous amount of legislation.

The great Macadam introduced the broken-stone road; then Thomas Telford, the great public benefactor, came with his improved macadam, until now, all over the great broad land, the march of civilization is manifest in the magnificent public highways of travel that exist. The cities and towns over the country have also felt the impulse of increased commercial intercourse; have experienced the benefits and seen the increased public health among their citizens, largely brought about by better roads and better streets, until they, too, have expended untold millions in that direction in the way of trying various plans and various pavements, until there, also, we have seen in the busier portions of the cities the gravel, the cobble-stones, the macadam and the Nicholson come and go. They have served their day and purpose. The beautiful elastic sheet asphalt and the asphaltum blocks came but for a brief interim, to be superseded, under heavy traffic, by the Belgian block, the last only holding its day for one redeeming quality—durability. And now we are on the advent of the vitrified brick pavement, wherein the acme of perfection under all circumstances has been nearer reached than in any other pavement that has ever been devised. Brick pavements have been in use in Europe for over a century; Amsterdam has one over a hundred years old; the Hague has one over thirty-six years old; they are found in Rotterdam and other large cities of Holland; and yet, nowhere are they so perfect as in hundreds of the cities and towns of America, where they are being used to-day. In the latter, some of which are seventeen years old, all are in good condition and proving highly satisfactory, and so it has come to stay.

The cost of vitrified brick pavements in most of the nearer cities and towns in this country, all complete, material, labor and foundation, without grading, is from $1.75 to $2.25 per square, being among the cheapest known.

This is what we might call an ideal street of the future down the thoroughfare of some large city: It will be a metal floor of iron, covered with an elastic substance, upon which vitrified brick will be paved, and supported with columns, with a large open subway beneath for electric street cars, pipes and wires. The busy world is making great strides in this direction, and the intelligence and enterprise in this country will accomplish wonders; and who knows what the future will bring forth in the next twenty years to come?

THE PORTLAND CEMENT INDUSTRY IN EUROPE AND AMERICA.

By Pierre Giron.

THE present annual production of Portland cement in Europe amounts to over 20,000,000 bbls.; and its commercial value to over $36,000,000. The first factory was established at Northfleet, on the Thames. The process was so crude that in 1850 only four factories were in operation. In England there are now over 8,300,000 bbls. made each year. The process used there is about the same as it was twenty years ago. The raw materials are chalk and clay, both very pure, and, although inferior processes are used, they make a satisfactory cement. A few years ago the entire product of the kilns was put on the market, but the fineness of the Continental cements led English makers to improve their facilities, although even now, English cement is not, as a rule, as firm as Geneva or French Portland.

The manufacture was first introduced into Germany in 1852. To-day there are sixty large works, having the same annual production as England. The raw materials are of exceedingly unfavorable character, but the makers have made a serious study of the properties and uses of Portland cement, and the producer now knows exactly what rules to follow to regulate his operations, and the consumer can depend on the product offered him. The association of manufacturers has had much to do with the immense development of the industry in Germany.

In France the industry grew slowly, the total output in 1880 hardly exceeding 750,000 bbls. a year. To-day the output is 1,800,000 bbls. The works of the Company of French Cements, at Boulogne-sur-Mer, form the largest Portland cement factory in the world, turning out about 800,000 bbls. a year. In Russia the first works were established in 1857, and there are now eight Portland cement works, making 900,000 bbls. a year. In Belgium there are four works, producing 800,000 bbls. In Italy the Portland cement industry does not properly exist, although a certain kind of natural Portland is made. In Denmark, Norway and Sweden, there are ten factories, making about 800,000 bbls.

Portland cement was imported into the United States as early as in 1868. In 1882 the amount imported was 370,406 bbls., and last year it exceeded 8,000,000 bbls. But little effort has been made to develop the manufacture in this country. The materials for manufacture are as hard to handle as any in Germany, and the processes are similiar. These are: (1) Grinding the rock into fine powder. (2) Molding it into bricks. (3) Drying the bricks. (4) Burning in an intermittent kiln with alternate layers of coke. (5) Grinding the clinkers.

These operations require about eight days, and require great care to produce a uniform product. The cost of the system is too great to make it successful in America. The process used in the Portland cement works at Coplay, Pa., has entirely revolutionized the science of cement-making. Here the raw compound is burned in a powdered condition while traveling in an inclined rotary furnace in an intensely hot petroleum flame, and a few hours is sufficient to finish the process. The cement is guaranteed to stand 400 lbs. in seven days, 500 lbs. in a month, and 600 lbs. in three months, and to leave no more than ten per cent. residue on a No. 80 sieve.

DIFFERENT METHODS OF PAYING FOR STREET IMPROVEMENTS.

THE Rochester, N. Y., executive board recently instructed its clerk, T. J. Neville, to ascertain from the principal cities of the country the different methods of assessing for street improvements, and what kinds of pavements were regarded as the best, in point of durability and cost. The replies were nearly all from cities in the eastern states. The majority favored stone and asphalt. The following is a summary of the information regarding the methods of paying for improvements and the kinds of material in use in the different cities:

Erie—Abutting property per lineal foot, street intersections general tax; asphalt.

Brooklyn—Fifty per cent. on certain area of adjacent property, twenty-five per cent. on area of lot, and twenty-five per cent. on front foot; granite block.

St. Louis—Abutting property per lineal foot on basis of one-fourth valuation of property; granite block.

Lynn—General tax; granite block.

Providence—General tax; granite.

San Francisco—Abutting property per lineal foot; basalt block.

Paterson—General tax; Belgian block.

Denver—Abutting property per lineal foot, two-thirds cost and one-third general tax; asphalt and stone.

Fall River—General tax; granite block.

Detroit—Abutting property per lineal foot, repairing by city; Medina block.

Worcester—General tax; granite block.

Lowell—General tax; granite block.

Chicago—Abutting property per square yard, street intersections one-half to property and one-half to general tax; granite block, asphalt and cedar block.

Troy—Abutting property by square foot of area, property assessed one -half expense and one-half on general tax.

Springfield, Mass—General tax; granite block.

Portland, Me.—General tax; granite block.

Reading, Pa.—Abutting property per lineal foot; block asphalt.

Syracuse—Abutting property per lineal foot; vitrified brick, Medina stone, and asphalt.

Baltimore—Abutting property per lineal foot two thirds expense and one-third general city tax; Belgian block.

New Haven—Abutting property per lineal foot two-thirds expense, and one-third general city tax.

New York—Abutting property per lineal foot, repairing at cost of city; granite block and concrete.

Boston—General tax; granite block and concrete.

Buffalo—Abutting per lineal foot; Medina stone.

Philadelphia—Abutting property per lineal foot, street intersections from city tax; Belgian block and sheet asphaltum.

Indianapolis—Abutting property per lineal foot, street crossings in part paid from general tax; Trindad asphalt, brick pavement.

Of the above number of cities, six assess for pavements, and presumably for all street improvements, by the lineal foot of frontage without regard to the depth of the lot or parcel of land, or to its condition in respect to buildings or improvements. Ten of the cities make the assessment by levying a part of it on the land according to the lineal or square foot and part on the city at large, while others distribute the expense on the principle that certain adjacent territory is benefited, and others on the basis of the assessed valuation of the property.

CHANGE IN STANDARD LENGTHS OF SEWER-PIPE.

EIGHT hundred responses were received by Blackmer & Post to a recent circular addressed to city engineers, sewer commissioners, reviewers, and others interested in sanitary matters, asking opinions as to the advisability of making sewer-pipe in 2½ feet, instead of 2 feet lengths as generally made. Fully 95 per cent. of these expressed approval of the proposed change, for the following reasons:

With the longer section better alignment and grade can be secured; there is a considerable saving in time, labor and cement in making joints, and, as one joint in every five is avoided, the completed sewer is stronger and better.

This action has led the firm named to change its standard of length to 2½ feet for all pipe hereafter made, and other makers will doubtless follow to meet a well expressed demand for longer sewer-pipe. No change is made in the T and Y junctions, which will be 2 feet long as before, as such a change would operate against the use of the fittings of other manufacturers, and necessitate a change in the price-list. Another improvement that has met with marked approval, is an increase of 50 per cent. in the socket-length of double-strength culvert pipe, and all sewer pipe. The sockets are made of the same thickness as the shell of the pipe and they now put corrugations around the inside of the socket and outside of the spigot-end for the purpose of giving a better bond to the cement and thus making a stronger joint.

PRIZES FOR ESSAYS ON GOOD ROADS.

COL. A. A. POPE, president of the Pope Manufacturing Company, of Boston, who is one of the foremost American advocates of improved highways, has decided to give away one hundred Columbia bicycles as prizes to essayists on the subject of "Good Roads." They will be apportioned among all the states of the country, at least one to each, one to the District of Columbia, and the remainder according to population. They are to be given to the authors of the one hundred best essays on "Good Roads," which may be confined to any phase of the subject, or a general article may be written. Each essay must be not less than five hundred words in length, must be published in some paper or periodical, and must be submitted in the published form in which it was first printed. The standing and character of the paper will have weight in the final decision. Points that will be considered are: general adaptation to the subject; practical value of suggestions; evidences of study given to the question; style and clearness of diction. A marked copy of the paper or magazine containing the articles must be mailed to "Road Department, Pope Manufacturing Company, 221 Columbus avenue, Boston, Mass.," and a sealed envelope, containing the name and address of the writer, and the name, date and address of the paper in which the essay was published, must accompany it. All essays must be in the possession of the company not later than May 1, 1892. Not only is this wise and commendable enterprise, but it will do much to stimulate interest in the road improvement movement.

TESTS OF MISSOURI BUILDING AND PAVING STONES.

MR. Hiram Phillips, consulting engineer of the University of Missouri, has completed arrangements with State Geologist Arthur Winslow to make a report and an extended series of tests of the building and paving stones of that State. The scheme as now outlined will embrace a personal visit to all the quarries and ledges of any importance in the State, and the breaking of at least 5,000 specimens. It is the present intention to have the test specimens prepared by convict labor at the penitentiary, and have them broken with the University testing machine. As the investigations will be more extended than any ever undertaken, Mr. Phillips invites, through PAVING AND MUNICIPAL ENGINEERING, letters of suggestion and advice regarding just what scheme should be pursued in makng the test, and just what points should be considered and their respective weights.

A ROAD ASSOCIATION IN NEW JERSEY.

A ROAD convention was held in Trenton, N. J., at close of the meeting of the New Jersey Board of Agriculture in January, and after several pointed addresses on the subject of highway impovements, a permanent association was formed. The following officers were elected: President, Edward Burrough; vice president, Chauncey B. Ripley; secretary and treasurer, Franklin Dye. Interesting papers were read as follows: "The Value of Good Roads," Dr. J. C. Mackenzie; "Construction and Repair of Country Roads," James Owen; "Permanence in Construction of Roads,' Dr. Chauncey B. Ripley; "The Importance or Need of Engineering Skill in Permanent Road Building," Robert E. Meeher; "European vs. American Roads," Thomas Dudley.

WHEN ROAD ROLLERS CAME INTO USE.

THE O. S. Kelly Company, of Springfield, O., has issued a very handsomely-printed pamphlet describing in detail their steam road roller, and also giving a brief history of road-making. Referring to the introduction of the roller in methods of road-making, it says: "The most important auxiliary to good road-making, and by many engineers deemed absolutely essential, was supplied by M. Poloncean in 1834 by the introduction of the steam roller. Formerly a road was opened to traffic, immediately the broken stones were put on, but this was inconvenient and caused heavy rollers drawn by horses to be used to compress and consolidate the material. The loose stones were much displaced by the horses' feet in consequence of the great exertion necessary to draw the roller. Steam rolling, however, has proven to be better and more economical, and although of comparatively recent introduction is

now regarded as essential, the largest rollers being considered the best and most economical to use. The steam roller also plays a most important part in road repairing as well as road making; in fact, so successful is the steam roller that horse rollers are but rarely used."

STREETS OF THE DISTRICT OF COLUMBIA.

THE annual report of Capt. Rossell, as assistant engineer commissioner for the District of Columbia, was filed recently. It shows the character and extent of street improvements in the district, city and county, to be as follows:

Carriageway.	Length (feet).	Square Yards.	Miles.
Sheet asphalt	262,570	1,087,858	49.7
Coal tar	201,640	881,939	38.2
Asphalt block	53,410	242,736	10.1
Granite block	129,621	609,687	24.5
Cobble and blue rock	57,302	440,754	10.8
Macadam	34,902	293,218	10.4
Gravel	138,675	530,188	26.2
Total improved	898,120	4,086,380	169.9
Unimproved	949,473	1,167,672	65.6
Grand total	1,247,593	5,254,052	235.5

SUBURBAN (LAID SINCE 1888).

	Square Yads.
Asphalt	65,878
Granite block	16,994
Macadam	41,891
Gravel	74,545
Total	199,308

THE DEMAND FOR ROAD MACHINERY.

THE American Road Machine Company of Kennett Square, Pa., at their annual meeting declared a cash 6 per cent. dividend. The officers and board of directors elected are as follows: Board of directors, Geo. W. Taft, S. Jones Philips, Edward Lewis, Wm. M. Davis, and Henry C. Davis. Officers: President, Geo. W. Taft; vice-president, Edward Lewis; secretary and treasurer, S. Jones Philips. The company recently added some new and improved machinery, and intend to build more machines than ever the coming year. Their sales for 1891 exceeded those of any previous year by more than one hundred machines. They have now positive orders booked for 500 machines for 1892 for the West.

THE DEMAND FOR CEDAR PAVING BLOCKS.

THE Ross Sapless Block Paving Company, of Saginaw, Michigan, increased their output thirty per cent. in 1891, over 1890, making in round numbers 100,000 yards of their sapless cedar blocks, of which 35,000 yards were laid in Saginaw, 40,000 yards in Grand Rapids and 10,000 yards in South Bend, the balance in small quantities, one consignment going as far east as Harrisburgh, Pa. It is claimed that where these blocks have once been used they give such superior satisfaction that they supplant other wood paving material at once. They make an economical and noiseless pavement. Mr. John S. Porter, the secretary and treasurer of the company, says the outlook now is that the capacity of the two mills, which is 150,000 yards per season, will be taxed for 1892.

PAVING BRICK CLAY IN MINNESOTA.

MR. M. B. HAYNES, city engineer of Mankato, Minn., in his annual report favors the use of brick for paving purposes in his city, and says that he thinks there is a quality of clay near Mankato suitable for the manufacture of paving brick.

A PROPOSED ROAD-MAKING EXHIBIT.

GEORGE M. ROBERTSON, secretary and general manager of the Elmira (N.Y.) Inter-state fair, is arranging for practical tests of road-making materials and machinery at the next fair, which will be held the latter part of August and first of September. It is his purpose also to organize an association with the purpose of awakening greater interest among the farmers of New York and Pennsylvania in country road-making.

BENEFITS OF A ROAD MACHINE.

To the Editor of Paving and Municipal Engineering:

SIR—In the January number I find a very true picture of the ordinary country road in clay districts, and in most country districts. Fortunately, I live on higher ground, and where we have the best of gravel for road-making. Our town, Duane, has good roads, in fact, the best country roads I know of, but with the present system of taxation for road repairs, we are always at a disadvantage. The amount as assessed for road purposes, if paid in cash and expended by a competent man, would keep our roads in the finest possible condition. The town owns a road machine, and we find it a splendid investment. The only trouble in using it is the disposition to go too fast and make the road too narrow.

A. R. FULLER.

Meacham Lake, N. Y., January 18, 1892.

STREET CLEANING IN WASHINGTON.

According to a recent article on street cleaning, by Conway B. Hunt, the organization of the department of street cleaning in Washington consists of a superintendent in charge, with the necessary assistants and inspectors, and a hired force of horses, carts and laborers. The operations of the department are confined to the sprinkling and cleaning of the improved and unimproved streets and alleys, the cleaning of the gutters and sidewalks, cutting of weeds and grass where necessary, and similar duties. Ashes and garbage are not cared for by this department. The former are left to the householders to remove at their own expense, while the latter is under the control of the health department.

The cleaning of streets is at present performed by contract, at the rate of thirty-three cents per 1,000 square yards, for each sweeping. The improved alleys are cleaned under another contract at the same rate. The remainder of the work is done by hired labor, supplemented to some extent by men from the district workhouse. The extent of streets swept by the contractor is as follows:

Pavements.	Square yards.	Length, miles.
Sheet asphalt, city and suburbs	970,487	43.77
Coal tar, city	881,039	38.2
Asphalt block, city	200,103	8.6
Granite block, city and suburbs	591,272	24.0
Wood, city	5,611	0.3
Cobble and bluerock, city	452,614	11.5
Total	$3,102,026	126.37

The contractor uses ten 4-horse sweepers, five of the Wright and five of the Filbert pattern. The sweeping is done by night, except when the contrary is specifically authorized.

The amount of material removed from the streets averages 1½ cubic yards per sweeping to every 3,000 square yards of area swept. Before sweeping the route is sprinkled by the contractor at his own expense. The average force employed by the contractor, beside the ten large sweepers, consists of four sprinkling carts, from forty to fifty broom, hoe, and shovel men, and thirty to thirty-five carts. The maximum force here named will clean 900,000 square yards of pavement in twelve hours. The total cost of the cleaning is divided between the government and the city, the cost per capita being about twenty-one cents per year.

PAVING BRICK DISCUSSED BY BRICK MANUFACTURERS.

The sixth annual meeting of the National Brick Manufacturers' Association, held in Washington, D. C., from the 12th to the 16th of last month, was attended by about five hundred persons whose interests were identified with those of the Association. President Adams, of Indianapolis, delivered an address at the opening of the meeting, and Treasurer McAvoy submitted a report showing that the receipts for the year were $887 and the expenditures $734. A resolution was adopted designating the *Clay Worker* as the official organ of the Association. The election of officers resulted: President, C. B. Pearson, Washington, D. C.; first vice-president, E. M. Pike, Chenoa, Ill.; second vice-president, Chas. B. Siner, Philadelphia; third vice-president, John McCain, Denver, Col.; recording secretary, Charles P. Merwin, Berlin, Conn.; corresponding secretary, Theo. A. Randall, Indianapolis; and treasurer, Frank B. McAvoy, Philadelphia.

At the fifth session of the Association a paper by George H. Brown, of Sioux City, Ia., on "Paving Brick," was read as follows:

Mr. President and Gentlemen of the Convention:

According to my idea of the fitness of things, the Honorable Secretary, Mr. Randall, when he selected me to prepare an essay on "Paving Brick," exposed his ignorance.

It would most certainly be presumptuous in me to appear before this convention, if I were inflated with the idea that I was about to teach men something who have had ten times my experience in the art of making "paving brick."

A moment's reflection, however, will show that the fundamental cause which brings us together is, that great good can not help but come from the enormous experience which is here gathered in the aggregate, and that free discussion and personal contact is bound to bring it to the surface.

With this apology, I will proceed briefly, to give short extracts from my experience.

It goes without saying, that in order to make a paving brick at all, you must have a suitable clay. Year before last, there lived a man in our town, who advertised quite extensively, that for the moderate fee of ten dollars he would impart the secret of making a paving brick, so that no man could go astray, no matter what his clay was. It is barely possible, that one or two members of this convention may have corresponded with the gentleman. His name was McCaughey, and the town he lived in was Sioux City, Iowa. But Sioux City never did have the name of being a moral place. Any way, I defy any body to give you a receipt for making a paving brick, unless you've the proper clay or mixture of clays, and if you've got that, all you need is to grind your clay fine, put it through a stout machine which will press it hard, dry your brick in forty-eight hours in a steam dry house without checking them. Set them in a down-draft kiln, burn them hard as you can without sticking the whole kiln together, so you have to blast them to get them out, put them on the cars standing waiting on the switch and ship them off, to ready and anxious purchasers at ten dollars per thousand. All of which, as my friend and neighbor Holman sadly remarked one day, "is mighty easy to tell but darned hard to do."

Seriously, however, the first step in making a paving brick is the thorough preparation, or "tempering" of the clay. *It must be ground fine.* I do not believe that a first-class paving brick can be made where there are lumps as big as peas scattered all through them. It may make a hard brick good enough for sewers, and for similar purposes, but it wont be a paving brick. Our own clay is hard to manage—what is known as refractory clay. We run it through two dry pans, and a pug mill, but are dissatisfied with the texture even then. The clay is dug with a steam shovel, and consequently goes into the pans direct from the bank. It is damp, very tough and inclined to be sticky and to stick under the "ploughs" in the pans. The finest paving bricks I ever saw in my life, bar none, are being made to-day at the Northwestern Sewer Pipe Works at Sioux City, where the clay, after going through a dry pan, is put through two wet pans, and that to my mind is a solution of the question: *Provided*, that sufficient capacity can be obtained by means of wet pans. That is a point which I am not competent to determine, but one that the makers of wet pans would do well to study, and perhaps improve upon.

Having got your clay well "tempered," the next thing is to pass it through a machine which will *compress the utmost amount of clay into a given space* Your bar of clay must be as dense, solid and hard as you dare to work your machinery. A soft bar of clay means a great shrink in the drying and burning, and an exaggerated change in the size of the brick in passing from the green to the dry state is sure to entail more or less checking and warping, and the result be a weak or distorted brick, to say nothing of the difficulty of handling, and the greater percentage of loss. Every body knows that there is a vast difference in the shrinkage of different clays, but in my judgment when you are making a stiff mud brick, make it stiff as you can both by heaviest possible pressure in the machine, and by avoiding too lavish use of water.

The next point is the drying. A great deal could be said on this point which would not properly come within the scope of this paper. Our company dry their product in a steam dry house, heated by both exhaust and live steam, and having a capacity of seventy-five thousand brick per day. We use the tunnel system, with which you are all familiar, and my only object in mentioning it is to say, that our great fear of checking the brick by too speedy drying was unfounded. Personally, I believe that any clay which will make a paving brick, can be readily dried by steam, and with less danger of checking or warping, than of sun-dried.

Neither do I believe that the quick drying "rots" the brick, or "takes the life out of it" in the least degree. I know that some experienced brickmakers claim this is the case and defend it vigorously, but I never heard of a well authenticated instance of it; while on the other hand, I have visited some score of yards in the country where the product is dried by steam with the most satisfactory results.

Another fact must be carefully borne in mind: that with tracks and cars, two men will "off-bear" 75,000 brick a day to the dry house, and two men will furnish 75,000 a day to the setters, as against an average of fourteen men to "off-bear" the same number for sun drying and, twelve men to furnish an equal number to the setters if wheeled from the sheds or racks. That is to say that four men will do the work of twenty-six by the steam-drying process, although the coal consumed in furnishing steam for the dry house must be taken into account as an offset.

We now come to the final stage of the game, viz.: the burning; said to be the most important of all the various steps in making a paving brick. For my part I think one step is just as important as another. You may get a first class burn on a poorly made brick out of poor material, and yet you wont have a paving brick. The burning, I think, is probably the most difficult part of the business, but with proper care and experience there is no need of throwing away money and time on bad burns, although the first requisite toward a good burn is a well built down-draft kiln. My advice to one about to build a kiln for burning paving brick would be: 1. Build a down-draft kiln. 2. Don't be afraid of spending an extra dollar or so in buying fire brick for lining; they will pay big dividends. 3. Clamp your kiln in the very best manner. If you produce a bona fide paving brick, your kiln will need strong bracing. Put a double crown on your kiln—two courses of brick—lower course eight inches, upper course two inches.

In burning your brick do not "vitrify" them. Burn them until their "whiskers" curl if you like, but if you "vitrify them," you will have to take them out with crow bar, hammer and cold chisel, and you'll find it wont pay. I've tried it—tried it all one summer, and I know. Some of you may remember that at the Indianapolis Convention, I tried to glean some information about burning paving brick in a continuous kiln. Well, I could not glean worth a cent. The only "vitrified" paving brick I ever saw in my life (and I've knocked around considerably in search of information), I say the only "vitrified" brick I ever saw, I took from the bottom of one of the chambers in our continuous kiln; it was a yard long and about as thick as my wrist, but it was "vitrified" all right. [Laughter]

Gentlemen, this is a very serious matter. We have allowed ourselves to fall into a grave error, and a glance at any dictionary will prove it. Webster defines the word "vitrify" as follows: 1. "Verb transitive (from the Latin Vit eus from Vitrum, *glass*, and facio, *to make*). "To convert into glass by fusion or the action of heat." 2. Vitrify, verb intransitive—"To become glass—to become converted into glass." The matter does not admit of argument. Like a motion to "adjourn," it is not debatable (and I am afraid there are many here who would like to make that motion right now).

I am very earnestly of the opinion that the improper application of this word is an injury to the paving brick industry because it is not true. If a manufacturer produces a brick which, when broken, shows a glassy fracture clear through, he calls it "vitrified." (I've done this myself.)

To say that he is right is to argue that the process of fusion begins at the center of a brick and works to the outer surface, for logically if it began at the outside and worked toward the center, the whole kiln would melt into a worthless mass before the process of vitrification would be completed.

The abuse of the word arose from its application to sewer pipe, where it is correct in a certain sense, the *outside* of good pipe being glazed with salt to nullify the action of water and acids in sewers, and this outer covering is of course vitrified or fused, though it adds nothing to the crushing strength of the pipe. If it were only applied to the outside of brick no harm would be done, but *as used*, it tends to convey the impression, that the brick is vitrified all the way through, and that this peculiar characteristic adds greatly to its strength. This is traveling under false colors, though, perhaps, not intentionally so. It is a misnomer and calculated to mislead. Furthermore, it shows up the whole craft in a ridiculous light, for if you vitrify a brick, (convert it into glass) that is, you defeat the very object for which the brick was made, for it will be as *brittle* as glass and absolutely worthless as paving material. I sincerely trust that such prominent journals as the "CLAY-WORKER" and the "*Brick-Maker*," both such valuable allies of the clay working industries of the country, will strike the word from their columns and insist that a genuine paving brick be called a *paving brick*. That is honor enough for any brick that will stand (say) 5,000 pounds to the square inch, and absorb no more water than (say) five per cent. of its weight.

We burn our pavers in five Eudaly square kilns—holding 220,000 brick each. First kiln we burnt, we turned out a very good specimen of a *sewer brick*. Kilns cost so much money I was afraid of burning them down. After that we did better, and did not use so much coal either. Began hard firing sooner. We endeavor to burn them j-u-s-t so they will "stick" a little. Our clay will stand lots of fire, and we consume practically speaking, one ton of coal to a thousand brick. We put the same quality of brick into the continuous kiln, which we burn for building purposes. There the cost is precisely one-fifth of a ton to a thousand. But, as we all know, there can be no set rule, no two clays being alike, and there being a vast difference in quality of coal. There is no doubt but that in the down-draft kiln, the burner is enabled to hold the heat at any given point for any length of time required to thoroughly shrink the brick to the degree of hardness which his clay will stand, or until this so called "vitrified" point is reached. This point, each one has to learn by actual experience, but to my mind, the tough and practically indestructible quality demanded in paving brick is imparted to it during the last (say thirty-six hours of the burn, when the heat is kept steady at a certain point of intensity, and the brick

is going through a peculiar *annealing* process. Granted that the clay be well and thoroughly tempered. This final touch will turn out a brick of fine grain and close compact body, which people have gotten into the habit of calling "vitrified," but which is simply an absolute amalgamation of all the particles of the clay into a perfect homogeneous mass of wonderful compactness, hardness and toughness. Care should be taken that when the kiln is closed that it be kept closed until it is certain that contact with the air will not injure the brick. A kiln of paving brick can not be fooled with in that way with impunity, and are very different from a "clamp" full of building brick.

One other point I would like to elaborate a little, viz.: the great desirability of uniformity in pavers. I believe that one great factor toward this end is the steam shovel. Almost invariably a clay bank has several strata or veins, each radically different from the other, and demanding different treatment in all the stages of manufacture. In digging clay with pick and shovel, aided by an occasional blast, it is impossible to obtain the same mixture of clays, and the consequence is a wide divergence in color, texture and hardness. The peculiar *slicing* action of the dipper of a steam shovel, as it moves vertically up the face of the bank cuts all the different veins of clay and thoroughly mixes them together in a way that can not be attained by any other means. The machine can be operated for $10 per day in our State, counting interest on investment, repairs, coal and labor. On a basis of 40,000 brick per day the cost would be 25 cents per 1,000 brick, and would be a paying investment; on a basis of 60,000 per day the profit of the investment is enormous.

In conclusion I desire to call the attention of the convention to the great desirability of cheapening the cost of paving brick so that they may come into more general use, not only to pave streets but country roads, and in the hope of provoking discussion which may throw some light on the subject, will note briefly two or three beliefs which I entertain:

First. That the time is rapidly approaching when the stiff mud process will be superseded by the semi-dry process. The latter is not applicable to *all* clays, but I think would be to all paving brick clays. If this is true, we do away at once with the costly and cumbersome dry house and its thousand attendant evils (a recital of all of them would fill a book), and effect an enormous saving per thousand, to say nothing of having a better brick and a better finished brick. The clay would have to be prepared better, which would involve some cost on the other side, but the saving would be ten times greater than the cost of additional preparation. A great factor in this revolution would be a determination on the part of manufacturers of dry press machines to put their prices at some reasonable figure; within the reach of a man who don't care to put a fortune into a brick machine; for instance, willing to sell 100 machines at 10 per cent. profit each, rather than ten machines at 100 per cent. profit each.

Second. I believe that in less than five years we will be burning our pavers in a continuous kiln at less than half the cost for fuel and labor that a down draft kiln now involves. I admit that I tried it and did not succeed, but I perceive so many and such decided points of superiority in the continuous kiln, that I feel convinced the genius of some hard-headed brick-maker will soon hit on a plan whereby the intense heat demanded can be controlled absolutely; carried to any part of the chamber desired, and *held there*, instead of rushing through the flues at the bottom and melting the brick there while the brick at the top are "salmon."

Third. The next great question confronting manufacturers of paving brick, and one of paramount importance as pertaining to cheapening the cost, is the fuel question. Either oil or fuel gas will be used; *must* be used in order to effect the desired saving.

Fourth. I believe a paving brick should be 9x2x4, instead of 8x2¼x4, and that this alteration in shape, although the cubic contents of the brick will be the same, would effect a saving of 15 per cent. in coal, and an equal amount in time of burning and cost of labor. [Applause.]

DISCUSSION.

J. G. SHEA, Decatur, Ill.—I can not let that paper pass without criticising it. I want to take issue with Mr. Brown. He says that a brick that is what we call vitrified to the heart will show a glassy fracture and is unfit for paving. I know this is not the case. We have many millions of that kind of brick in use in the West, and they are standing not only heavy traffic but the frost and rain. I have no fault to find with the rest of the paper, excepting the dry press process for paving brick. He says it will precede all others. I understand there are 250 streets of the United States about to use brick for paving their streets, and I want to ask if any of you know of any street paved with dry press paving brick.

MR. DRUMMOND, St. Louis, Mo.—In answer to the gentleman, I will say we had a contract with Hannibal, Mo., for four million of brick to be made by the dry press process, and another contract for dry press pavers for the city of Danville, Ill., so I feel that we are not going to be entirely wiped out by the other processes in making pavers.

MR. CHAS. PURINGTON, Galesburgh, Ill.—I think the gentleman who prepared the paper is wrong in regard to our being unable to make vitrified brick. With the clay we are using we have no trouble, whatever with the brick sticking. We had some little trouble some time ago by leaving our sand off, thinking it would give a more glossy appearance to the outside of the brick—not to help the brick—and we had a kiln badly stuck, but by putting sand on the outside we have no trouble of that kind whatever.

MR. EUDALY—I know Mr. Brown, the writer of this paper, quite well and I think it is, perhaps, fair to the convention to know a little something about the circumstances under which he writes a paper, for there are statements in that paper which otherwise might be misleading. Mr. Brown is a very excellent gentleman and very successful. I do not think, however, that Mr. Brown ever made brick or had it done in any other bank of clay than the one he is working. This bank of clay out of which Mr. Brown is manufacturing street paving brick is unlike any other clay bank I have ever seen, being used for the manufacture of any kind of brick. It is a very peculiar bank of clay, indeed, and I, like Mr. Brown, believe that if it was burned so as to have a slick, glassy fracture like the Purington or Des Moines or many other paving brick, it would be ruined for paving purposes. I think it is impossible to give it that glassy fracture. I know they have tried to do it. Mr. C. J. Holman has been manufacturing brick from that bank of clay for some time. It is very hard to handle. The bank is very high and in looking at it for the first time one would think it was a stone quarry. It is unlike the clay that Mr. Purington uses in manufacturing his brick; it does not look like clay at all. This clay has quite a large per cent. of fire clay in it; so much so that Holman Brothers take out strata of fire clay to manufacture their fire brick.

MR. CRAFTS—I want to drop a little bomb right here. I don't believe a brick should be absolutely vitrified, and I think it very much goes to show that some paving brick which hold three per cent. of water stand the wear better than those that hold no water at all. I had occasion to build a road two or three miles long. I filled in some of it with broken stone and the rest with brick, just broken and small brick, and where we put the stone it ground down, and where we put in the broken brick we have not had to touch it.

MR. PURINGTON—Most of the specifications for streets paved with brick call for brick burned to vitrifaction. I don't say it is necessary.

MR. SHEA—I say it is absolutely necessary to vitrify a brick in order to get a good paving brick. That is my experience. I know that there are clays that will stand in streets without being vitrified, but there are very few brick that will do it. In many of the old brick-yards you can select out common, soft brick and put them in the streets and they will last many years. I have seen them where the traffic is not very heavy last as long as a great deal of the other material that they are using. In many of the southern cities, I believe, hard building brick will last in the streets many years, and from what information I can get on the subject I believe that is the kind of brick they are using in Holland and have been using for one hundred years. In the South you can use these brick, but in the northern cities where the traffic is very heavy, and the brick liable to be frozen, you must have vitrified brick to stand the wear and the frost. It is wonderful how common brick will stand in the streets, and the horses' travel over it will test the strength, but they must be vitrified to keep out the frost. This is my opinion and it is based on considerable experience. I not only burn brick but I lay them in the streets and my streets have given satisfaction. I can get a recommendation from any of the streets I have laid.

D. P. GUISE—I agree with the gentleman whose paper was read about the burning of brick for street paving. In fact when any hard substance comes in contact with the brick that is fluxed it is liable to chip off. I believe that a brick thoroughly burned just to the point of fluxing will give better service than one that is thoroughly fluxed. I have some experience in paving streets put down by contract, not of brick but other material, and I believe, as I said before, that a hard, well burned brick will give better service than one vitrified.

MR. SNELL—I think in this case, as in many others, all are pretty nearly right, but there are facts that are overlooked. I will take one clay and if burned to a state of vitrifaction it will crumble at the least little blow or the striking of a horse's hoof. I will take another clay and burn it to vitrifaction and it wont. It all depends on whether your clay will stand vitrifaction and not crumble. If it will you should vitrify them. If not, you had better not try it.

CHAS. PURINGTON—I would like to illustrate to you the hardness of our brick. We had an emery wheel about half an inch out of true, and by holding a brick on it half an hour we had that wheel down smooth without hurting the brick.

MR. ITTNER—I am not in the street paving business, but I desire to say a word or two on the subject of street paving brick. Brick were put down as an experiment in the city of St. Louis, and I was on the committee appointed to examine these brick after they had been down in the street three years and three months. They were made by Mr. Geo. Saddler from clay gotten about nine miles from St. Louis at a place called Bagnell, and the brick this gentleman made gave as good satisfaction in the streets as any paving brick ever manufactured in this country, and these paving brick were not vitrified. Mr. Adams said we must not fail to take into consideration different sections of the country, different clays and different situations and circumstances. Now, I believe some clays will not make a good street paving brick unless vitrified, and I believe another clay if vitrified would not be suitable for a street paving brick, whereas if fused to a certain extent would make good paving brick. That is one thing, gentlemen, we should not overlook in our discussions, and it is a fact that Mr. Brown has not been in the business long enough to get this idea engrafted in his mind—that different conditions produce different results. He speaks of a clay which he himself has had experience with and the only clay with which he has had experience. Now, if you were there and operating with that same clay, you would, perhaps, meet with a like experience, while others going to a different section of the country would meet with different experience. I have seen the brick manufactured by Mr. Purington at Galesburgh—I have a piece of one of his brick at home on my parlor mantel—it has been vitrified through and through and my opinion is there could hardly be a better brick for paving purposes. Now, it may be that his clay would not make a good brick unless vitrified. While others could not be vitrified, it would make them brittle like glass, while it might true an emery wheel, in the street it would chip all to pieces.

MR. THOS. B. MCAVOY—What is the reason that clay expands?

MR. ITTNER—I can not say. It is the nature of the clay. If some clays are over burned they become brittle like glass, that expands it. It has been subjected to too great a heat in the kiln.

MR. MCAVOY—Then there is no foreign matter in the clay.

MR. ITTNER—That I can not say. The clay will make as good a paving brick without being vitrified and last just as long in the streets as a brick made of different clay would last if it were vitrified through and through.

MR. CALLAWAY—I would like to ask Mr. McAvoy the difference between cast iron and malleable iron. That will answer his question.

MR. MCAVOY—I am not in the iron business. I am a brick-maker from way back. I say whenever you can get clay you can make brick. You can vitrify clay, you can not vitrify sand, and when you at-

tempt to make a paving brick out of anything that is not naturally clay you make a failure of it. Any man who has a clay bank that is free from sand or other foreign substance has a bank he can make paving brick out of.

MR. EUDALY—This question comes up at every convention, and it just struck me that if we could have a series of articles written and published in our official organ—one paper to contain the results of a certain kind of clay from a certain bank, an analysis of which should appear, so that we could know what could be done with that clay, and the next article give the results of the same clay burned in another kiln; and then the next paper with another kiln with different fuel, so that we could know what we are talking about. Now, I know pretty nearly every clay bank that has been referred to this afternoon, and you would be surprised to know how they vary and differ, and the gentlemen get up here and make strong statements when both are correct. It is the general understanding that a vitrified brick means a glossy fracture. Now I know that some clays burned to that point are spoiled. I am quite certain of it. That clay Mr. Brown speaks of could not be burned to that state. Some time ago I wrote an article about the various clays throughout the United States. Now Mr. Brown's clay is a peculiar kind of clay. If vitrified it would be brittle and fall into pieces like pieces of glass that has not been annealed; and there are other clays that must be burned to this glossy fracture, but here is a clean, clear statement—good paving brick should be burned thoroughly hard and as tough as possible to make it, and should not be burned beyond that point. It is not a question of a brick being burned until it will stand the greatest number of blows—and by observation you will find that engineers all over the country give this a great deal of attention—it is the kind of blows. We must always take into consideration the different conditions about which we are talking. Now the clay Mr. Shea was describing is just as unlike Mr. Brown's as it can possibly be.

MR. CRAFTS—Now, while I know my Brother McAvoy did not intend to say a word that was not true, yet, when he says you can not vitrify brick that contains sand, I think he is wrong.

MR. MCAVOY—If the gentleman will show me a brick vitrified with sand in it, I will show him a brick that is of no account.

MR. CALLAWAY—It seems a great deal of stress is being put on the necessity of vitrifying paving brick, which is correct. But there is another item that has been entirely overlooked, and that is that after the burning has been completed, the quality of the brick may be effected by the manner of cooling. You can burn a kiln to vitrifaction, and that kiln, after it is cooled off, if cooled off instantly, will become brittle, it will not stand sharp blows. If the same clay is annealed or cooled off gradually, it will be very tough and will stand any amount of blows and prove a very tough paving brick. While the burning is very important, and the quality of the clay, it is also very important to anneal your paving brick after they are burned. That is why I put that question to Mr. McAvoy, "What is the difference between cast iron and malleable iron?" The malleable iron is carried further than the cast iron. After it is cast, it is put into annealing furnaces and heated up and cooled off and it becomes tough. I say the annealing or toughening of the brick is just as necessary after they are burned as the quality of the clay and the burning. I merely wanted to make this point.

MR. MOULDING—I think this illustration we have just had is very apt. The annealing process is just so in this inkstand (holding an inkstand up to view), before it was annealed in the glass factory, if it were to fall two inches it would break it was so brittle, but now I can drop it several feet and it will not break.

MR. MCAVOY—If you will take two sand brick and knock them together, that is all of them. You take two brick burned from clay and you can slam them together and they will not chip off. I say that pure clay is the strongest material that can be produced.

MR. SNELL—I have taken brick from the same clay, both being thoroughly vitrified, and one was worthless for a paving brick, and by striking them together they would fly all to pieces, and I have taken other brick thoroughly vitrified and they were tough. What is the reason? The brick that would fly to pieces were the top ones, the first and second courses. Nothing below that. These I have had to throw away as being perfectly worthless as a paving brick. After four courses they were splendid paving brick, and I come to the conclusion that it was done by letting the cold air against them too quickly.

MR. MCAVOY—Now he is talking about burning brick. I say brick spoiled in the kiln is spoiled by too much heat and not air. Many people imagine that their burners go to sleep and let the heat go down. I say it is not true. Nine-tenths of the brick are spoiled by too much heat, and I know it.

MR. PURINGTON—I did not intend to have anything to say in this discussion, but the gentleman is entirely off, and every man who has anything to do with the manufacture of paving brick knows it. It is the introduction of cold air that makes the brick brittle and there is no getting away from it. You can not burn paving brick in an up-draft kiln. You can not give them that toughness which is necessary in a paving brick, and you can not burn brick with the toughness necessary to wear on a street in an up-draft uncovered kiln. To do that you must introduce so much cold air in the kiln that the brick become brittle, and consequently what Mr. McAvoy says is from a lack of experience on the subject. His experience in regard to common building brick is all right, but so far as paving brick are concerned he is away off.

Improvement and Contracting News.

PAVING.

Richmond, Ind., is to pave Main street with vitrified brick.

North Amherst, O., will expend $8,000 in street improvements.

Hamilton, O., is actively discussing the question of street paving.

San Bernardino, Cal., is to pave one street with vitrified brick.

Paving to the amount of $500,000 will be laid at Detroit, Mich., this year.

The city council of Tacoma, Wash., has voted to improve twelve streets.

The council of Atlanta, Ga., has set aside $150,000 for street paving this year.

It is quite probable that Main street, Clyde, O., will be paved this spring.

An ordinance has been passed to pave Main street, Quincy, Ill., with brick.

Brick pavements have been ordered on nine streets by the council at Evansville, Ind.

Massillon, O., will let a contract to pave one of its streets with brick in the near future.

Street improvement bonds to the amount of $100,000 have been sold at Waco, Tex.

Bills for $11,850 of granite and $7,568 of brick paving have been passed at Nashville, Tenn.

There are now about eight miles of paved and macadamized streets in Alliance, O., two miles of which were paved with brick last year.

At Boston, Mass., the mayor's estimate for the ensuing year includes $850,000 for street paving.

Plans and specifications are being prepared for the paving of certain streets at Indianapolis, Ind.

It is expected that Peachtree street, Atlanta, Ga., will soon be paved with asphalt its entire length.

It is expected that street improvements at Lynchburgh, Va., will cost more than $20,000 this year.

P. Ryan & Co. will pave Sherman street, Bay City, Mich., with vitrified brick at 77½ cents per yard.

A bill authorizing the city of Findlay, O., to issue $150,000 worth of improvement bonds has been prepared.

Over nine miles of cedar blocks and nearly two miles of asphalt, were laid at Toronto, Canada, last year.

The construction of plank sidewalks on four streets at Washington, D. C., has been ordered by the commissioners.

An election will be held to vote on the question of expending $75,000 for street improvements at Homestead, Pa.

At Los Angeles, Cal., several streets have been ordered graveled, and one street paved with bituminous lime stone.

Eight bids were received for the paving of South Market street at Worcester, O. Landers & Betson's was the lowest.

Bids for over $40,000 worth of street work has been awarded at San Francisco, Cal. The largest single contract was to Warren and Malley at $25,000.

The city engineer of Springfield, Ohio, has presented estimates for paving aggregating 7,779 feet, and to cost $94,278.

John F. Cleary received the contract for laying 7,000 feet of flag-stone in various parts of the city of Charleston, S. C.

Wallingford, Conn., will macadamize Center street from the town hall to Simpson's factory, as soon as spring opens.

The city of Toledo, Ohio, will spend $500,000 on boulevards this year. Stone sidewalks will also be laid on Broadway.

Plans are being prepared at Racine, Wis., for about one mile of cedar block paving, for which bids will soon be asked.

Athens, Ga., will have paved streets before the next rainy season. It seems that Belgian block is to be the principal material used.

The council of Harrison, O., has decided to improve Calvin, Dock and Jefferson streets by grading, guttering and macadamizing.

Street improvements are expected at Fleetwood, Pa., as soon as the weather will permit, on account of a new charter being granted the city.

It is proposed to pave the principal streets of New Castle, Pa., at an estimated cost of about $250,000, one-fifth of which will be paid by the city.

James E. Snyder, of Minneapolis, Minn., has been awarded the contract for 15,300 square yards of cedar block paving, to be laid in Chippewa Falls, Wis., at a cost of $19,400, including grading and curbing. There will be about 6,000 lineal feet of curbing and Berea sandstone will be used.

Harry P. McTague has been awarded the contract for paving South Fourth avenue, which is the principal thoroughfare in Mt. Vernon, N. Y.

The estimates for the departments of public works of Allegheny City, Pa., for 1892 include $90,000 for streets and $114,000 for sewers and highways.

The clerk of the board of public works has been directed to advertise for bids for 2,000,000 hard-burned sewer brick, to be delivered to the city during the present year.

The Committee on Highways has been instructed to procure estimates for paving Somerville avenue, Union Square, and a part of Webster avenue, at Somerville, Mass.

The council of Kissimmee, Fla., has directed that wood, brick or stone sidewalks be constructed on the three principal business streets. Wood will be used almost exclusively.

Charles O'Neill has been awarded the contract for improving Jackson avenue, Jersey City. Henry Byrne was also awarded the contract for improving Ninth and Eleventh streets.

Surveys and estimates have been made for general improvements to 17¼ miles of the public streets at Cincinnati, O., at a cost of $391.940. The contracts will be awarded in the spring.

The city engineer of Troy, N. Y., has been directed to prepare specifications for the asphalt pavement on Sixth avenue from Rensselaer street to the city line, and on Seventh street from State to Grand street.

Preliminary steps are being taken to submit to the people of Hackensack, N. J., the question of bonding for additional macadam, the purpose being to complete the work on all streets this year if possible.

The Warren-Scharf Asphalt Company offers to finish the asphalting of Bull street, Savannah, Ga., and wait until September for payment. It is estimated that the cost will be about $25,000, exclusive of curbing.

Fifteen thousand dollars is the estimated cost of paving Main street, Lock Haven, Pa. It is proposed to appropriate annually $10,000 for paving, in addition to the ordinary required out-lay for street repairs and improvements.

The estimated cost of street improvements for the coming year at Louisville, Ky., are: In the eastern district, granite, $482,000; brick, $197,000; asphalt, $32,000. In the western district, granite, $585,000; bowlders, $15,000; brick, $219,000; asphalt, $375,000.

The commissioners of Washington, D. C., have received ten bids for furnishing the District with vitrified brick. The lowest were that of McMahon, Porter & Co., $17.93 per thousand for pressed brick; American Fire Clay Company, $17.72 per thousand for ordinary brick.

Bids for widening Congress street near the Kellogg currycomb factory, at Troy, N. Y., have been opened. Joseph H. Cavanaugh, $1,100; Donovan & Darby, $1,325; Gilbert W. Flagler, $625; Richard M. Redmond, $945; George Winne, $595; William McLaughlin, $487, were the bidders and the amounts of their bids. William McLaughlin was awarded the contract.

Superintendent Burke, of the street department, Chicago, went East to inspect methods of street cleaning, street repairing and street paving in vogue in Eastern cities. He claims that Chicago is away behind in the matter of street paving, and that the great trouble lies in the fact that the paving is put down in too much of a rush.

The following are the names of bidders and amount of bids received by the city of Hannibal, Mo., for paving Broadway, with vitrified brick for a distance of 3,614 feet by 70 feet, amounting to 28,109 square yards: T. J. Shea, Quincy, Ill., $57,062.32; J. B. Smith, Chicago, Ill., $57,347.75; F. W. Menke, Quincy, Ill., $57,357.81; Becky Glann, Toledo, Ohio, $60,715.44; Rose & Reynolds, Hannibal, Mo., $63,104.75. Mr. Shea's bid being the lowest, he was awarded the contract. He is to furnish all material, labor, etc., and have the work, as specified, completed on or before September 1, 1892.

A summary of the report of Mr. Harvey Linton, city engineer of Altoona, Pa., shows that from 1888 to 1891, 106,593 square yards of paving were laid in Altoona at a cost of $302,100, of which 52 197.9 square yards were sheet asphalt, 22,876.1 asphalt block on concreate foundation, 14,464.4 asphalt block on stone foundation, 4,082 6 stone block on concrete foundation, 9,459.5 stone block on stone foundation, 3 983 vitrified brick on concrete foundation, 1,537.9 vitrified brick on stone foundation, 1,576.3 cobble stone. The details of this statement have been put in unusually comprehensive form, and will accompany the annual report of Mr. Linton, which has not yet been published.

SEWERS.

Freeport, Ill., is to have a system of sewerage.

$10,000 will be spent on a sewer to be built at Dunmore, Pa.

More than sixteen miles of sewers have already been laid at Newton, Mass.

It is proposed to build a sewer system at a cost of $300,000 at Brockton, Mass.

Sewer bonds to the amount of $14,000 have been issued at Highlands, Colo.

The proposed sewer on Valley street, Council Bluffs, Ia., is estimated to cost $17,000.

Greenville, S. C., is agitating for a bond issue to pay for a sewerage system to cost $75,000.

A bill is before the legislature intended to enable the village of New Rochelle, N. Y., to borrow $75,000 and complete its sewers.

Engineer Loweth, of St. Paul, is preparing plans for a sewerage system for Janesville, Wis.

An engineer has been instructed to prepare plans for a sewerage system for Elmwood, Mass.

The sum appropriated for sewer construction at Boston, Mass., during the coming year is $350,000.

Preliminary steps will soon be taken for the construction of over 8 miles of sewers in West Newton, Mass.

Plans for a complete sewerage system for Niagara Falls, N. Y., have been prepared by Johnson & Debaud.

The council of Nanticoke, Pa., has decided to submit the question of a sewerage system to a vote of the people.

It is projected to organize a local stock company at North Platte, Neb., to build a system of sewerage for the town.

The council of Hagerstown, Md., will appropriate $30 000 for the completion of the drainage system for that city.

Seven thousand dollars has been appropriated for sewers to be constracted during the coming year at Haverhill, Mass.

C. J, Swanson received the contract for furnishing Minneapolis, Minn., with 1.500,000 sewer brick at seven dollars per 1,000.

Sewers are to be built in Magnolia, Walker, Mitchell and other streets in Atlanta, Ga., at a cost of $50,000.

The board of public works of South Superior, Wis., will advertise for bids for building about three miles of sewers in the alleys.

Tarrytown, N.Y., is about to adopt certain improvements in the way of sewer flushing as per plans of D. S. Merritt, a local civil engineer.

The city engineer of Columbus, Ohio, has been instructed to prepare a plan for a sewerage pumping station, together with estimates of the cost.

The ordinance to issue $150,000 of bonds to pay for trunk lines and sewers at Reading, Pa., has passed. City surveyor will give details of letting contracts.

Ft. Smith, Ark., has an excellent sewerage system extending over the entire city. This system, covering twenty-five miles, is the most extensive in the State.

A sewer will be constructed on Ninth street in the village of Maywood, Ill., to cost less than $20,000. Work will begin as soon as the weather will permit.

Brayer & Albaugh were awarded the contract for the front street outlet sewer at Rochester, N. Y., at an estimate cost of $5,397.50 by the executive board.

An ordinance was approved for consolidating sewer districts Nos. 46, 60, 123, 180, at Kansas City, Mo., and constructing a sewer therein at a cost of $35,000.

Eight bids were received for constructing the West Liberty street sewer at Wooster, O. E. A. Williams, the lowest bidder, was awarded the contract.

About $40,000 of sewers are being prepared for contract at Denver, Colo. It is claimed that only half of the city is at present provided with a sewer system.

The city of Montgomery, Ala., will soon commence work on the construction of the south outfall sewer at that place; it will cost, when completed, about $8,000.

Herbert Cook, of New Bedford, received the contract for constructing an eight-inch sewer on Union street, and for a six-inch sewer on Walnut street at Fairhaven, Mass.

The brick and syphon pipe sewer outlet, to be built from the city mains to the river at Menominee, Mich., will cost the city $10,015. A Milwaukee firm will do the work.

The new sewer to be built on Read street, Chattanooga, Tenn., is to be 800 feet of ten-inch pipe, with two man-holes. It will extend from Rossville avenue to Read street, and thence east to Catherine street. The average depth will be about nine feet.

The committee on sewerage at Marlboro, Mass., has completed seventeen miles of sewers, and reports that four or five more are needed to cover the principal streets.

Sealed proposals will be received at the office of the city engineer until February 18, for the construction of about three miles of sanitary pipe sewer at Cedar Rapids, Iowa.

The council of San Rafael, Cal., is discussing the establishment of a complete sewerage system. The proposed plan includes pumping works and an outfall in the deep water on the bay.

The engineer recommended that the Liberty street sewer, between McLean avenue and Dalton avenue, Cincinnati, be repaired at a cost of about $2 per foot and the work has been authorized.

The city engineer has been instructed to make surveys of the proposed Willow Run sewer, with estimates of the probable cost and best material to be used, to report to the Council of Covington, Ky.

Bids have been opened for the construction of three sewers at Brooklyn, N. Y. Richard Whalen was the lowest bidder for each street, and is as follows: 12 inch cement pipe, 99 cents per lineal foot; 15 inch, $1.35; manholes, each, $37; street basins each, $95.

Chief Engineer Howard A. Carson, of the metropolitan sewerage commission, Boston, Mass., in his annual report, says that since ground was first broken in May of last year, about twenty-eight per cent. of the total work has been completed, twenty per cent, more is under contract, and surveys and plans have been made for the remainder.

Cairo, Egypt, a city of 400,000 inhabitants, has no sewerage system. Works of this sort were carried out during the reign of Ismail Pasha, but they were so defective that Greene Pasha, the English director of the sanitary service, destroyed them. Plans, however, have been prepared for a complete system, which will doubtless be begun the ensuing year.

BRIDGES.

A bridge will be built at Fourth street in Eddystone, Pa.

The trestle bridge at Bath, N. H., is in a shaky condition.

A new $15,000 bridge will be built over Clinton river at Mt. Clemens, Mich.

Bids will soon be asked for the construction of a $2,000 bridge at Lima, Ohio.

The bridge at White river junction, near Concord, N. H., is in bad condition.

A company is to be organized to build a bridge over the Youghiogheny river at Boston, Pa.

A bridge to cost $10,000 will be built over Brandywine creek at Chadd's Ford, Pennsylvania.

It is announced that a pontoon bridge across the Niobrara river, at Atkinson, Neb., is now assured.

The question of building a bridge across the St. Lawrence river above Morristown, N. Y., is again being agitated.

The town clerk will give details of agitation in favor of a bridge across the Potomac river at Williamsport, Md.

Raymond & Bay, civil engineers, San Francisco, Cal., are preparing plans for a steel draw bridge over Napa river.

A company has been organized at Chamberlin, S. D., for the purpose of putting a pontoon bridge at that point.

Oscar H. Peacock, city surveyor of Rochester, N. Y., will give details of the proposed Alexandria street bridge.

A new bridge is to span Money creek, near Towanda, Ill., and also a new one will span the Sangamon near Springfield.

The commissioners of Knox county, Ohio, will build a bridge across the Kokosing river at Mt. Vernon, at a cost of $30,000.

The borough council of Bethlehem, Pa., has under consideration a bridge across the Lehigh river at the foot of Main street, to cost $250,000.

It has been decided to erect a stone arch bridge over the Raritan river at the foot of Albany street, New Brunswick, N. J. The structure will cost about $100,000.

Daniel W. Marmon is petitioning for a new bridge over White river, at Indianapolis, Ind., to be located about one hundred feet below the Vincennes railroad bridge.

Bridge Engineer Gaylor is preparing plans and specifications for the new Twelfth street bridge, at St. Louis, Mo., which will probably be commenced early in the summer.

The committee on streets at Poughkeepsie, N. Y., has recommended that the bridges now in poor condition be repaired and that a new bridge be built over the Fallkill at Cherry street.

A bill has been introduced into the New York Assembly for a bridge across the Hudson river at Albany. It is to be a draw bridge twenty feet above water. The capital stock is $300,000.

A petition is being circulated on both sides of the river at Portland, Ore., asking that a free bridge be built from B street on the west side to F street on the east side, and that the bridge be sixty feet wide.

The board of public works will recommend to the council of Kansas City, Mo., the passage of an ordinance appropriating $3,500 to build a fifty-foot iron bridge over the belt railway tracks on Park avenue.

It is probable that the county court will constrct a bridge over the Platte river at a point on the state road between Saxton, Easton and St. Joseph, Mo., near where the Hannibal & St. Joseph railroad crosses the river.

A bill has been introduced into the Ohio legislature, authorizing Franklin county to issue bonds to provide for the construction of a bridge over Alum creek, in Mifflin township. The estimated cost is $20,000.

John O'Neil has been awarded the contract for the erection of new stone abutments at the State street bridge, Milwaukee, Wis. The Wisconsin Bridge and Iron Company have the contract for the superstructure.

City engineer Jackson will give details of proposed $130,000 bridge over the tracks of the B. & A. railroad on Cambridge street, Allston, Mass. The bridge will be 60 feet wide over the track and the grade will be filled up to the width of Cambridge street.

A bill was passed in the house providing for a railroad and wagon bridge across the Mississippi river at South St. Paul, Minn.

The report of the board of the United States engineers regarding the advisability of building the proposed new bridge over the Ohio river at Cincinnati, will be submitted to the secretary of war at an early date.

Judge E. B. Martindale and E. B. Osgood have notified the commissioners that they will petition for a bridge over Fall creek on Alabama street, Indianapolis, Ind., and said street will be converted into a boulevard.

WATER-WORKS.

Redwood Falls, Minn., has voted in favor of water works.

Salineville, Ohio, will spend $10,000 in establishing a water-works system.

The water works system will be improved at a cost of $6,000 at Ellington, Conn.

It is reported that $90,000 water-works bonds will be issued at Corpus Christi, Texas.

It is proposed to issue $50,000 in bonds for improving the water-works at Marblehead, Mass.

Cummings & Cook have received the contract for building water-works to cost $43,890 at Snohomish, Wash.

The common council of Lake City, Minn., has been instructed to get plans and specifications for a water-works plant.

A proposition was laid before the common council of Neenah, Wis., to put in a system of water-works at a cost of $55,000.

The council of Weston, O., is discussing the question of bonding the city for $10,000 to construct a system of water-works.

E. W. King, superintendent of the water company at Great Falls, Mont., expects to lay ten or twelve miles of pipe during the coming season.

S. B. Mosby & Co., of Bedford City, Va., have been awarded the contract for the construction of the reservoir at Atlanta, Ga., for $52, 374.

During the coming summer the water-works of Logansport, Ind., will be extended to meet the requirements, most pressing. In all, about three miles of pipe will be laid.

A committee has been appointed to ascertain the cost of a system of water-works for Middletown, Md., and the legislature will be petitioned for authority to issue bonds to construct the same.

At St. Albans, Vt., the contract for a new dam and storage reservoir and for a new supply main has just been let to engineer Lucien A. Taylor, Boston. The sum of $85,000 has been voted for this work.

Superintendent McConnell, of the water-works department at Montreal, Canada, recommends the purchase of an additional pumping engine, and his estimates for the coming year include 3,000 tons of pipe.

Hyde & Jackson, of New York, have made an application to the common council at Kankanna, Wis., asking for a franchise to put in a $100,000 water-works plant. It is proposed to put in seventy hydrants.

A water supply is projected for East Portland Heights, outside of the city limits of Portland, Ore. Either an independent pumping station or a connection with the works of the East Portland Water Company is proposed.

Excelsior Springs, Mo., is to have a $15,000 system of water works. St. Louis capitalists will establish the plant and the city will pay a yearly rental of $900 for seven fire hydrants. The works will be in operation by July 1st.

Supt. McAlpine, of the water-works at Columbus, O., says: "During the year 1892 we shall want fifteen miles of cast-iron pipe from six to twenty inches, providing the legislature authorizes the issuing of bonds for that purpose."

The city council of Los Angeles, Cal., has decided to recommend to that city the acquirement of public water-works. It is proposed to take the water from the Los Angeles river, and the estimated cost of the head works and reservoir will be $200,000, not including the distributing mains.

STREET LIGHTING.

St. Charles, Ill., has voted to put in a system of electric lights.

J. C. Boyd will establish an electric light plant at Springfield, Ore.

Crawfordsville, O., will borrow $20,000 to enlarge its electric light plant.

Town clerk will give details of proposed electric lighting for Meshoppen, Pa.

A plant is being erected to provide Knightstown, Ind., with electric lights.

The electric light plant at Seward, Neb., has been sold to Lincoln capitalists for $8,000.

The council of Highland, Ala., is investigating the cost of putting in an electric light plant.

The Camden Electric Light and Power Company, Camden, Ark., is in the market for an electric outfit.

The contract has been let and it is now assured that the city of Austin, Ill., will be lighted by electricity.

A company has been organized and an electric light plant will soon be established at Wichita, Tex.

A new electric light system will be established at Columbus, Ind. The present one has proved a failure.

K. Casper has the contract for lighting Nevada City, Cal., with the incandescent electric system for one year.

P. Harvey, of Chicago, is making an estimate of the cost of putting in an electric light plant at Oconomowoc, Wis.

E. Overman, the electrician of Charleston, Mo., will start work on the new electric light plant at Paragould, Ark.

The American Construction company has been granted a franchize to erect an electric light plant at Monroe, N. C.

The city council of Dubuque, Ia., is considering the matter of operating its own electric light plant for lighting the streets.

The council of Dayton, Tenn., has contracted with Burkhalter & Gibson to put in an electric light plant. The city agrees to take 12 or more lights at $120 per month for ten years.

Floyd Starret is negotiating with the citizens of Clinton, Mich., for the establishment of an electric light plant at that place.

George T. Warner is secretary and treasurer of the new electric light company, which will shortly light the town of Walton, N. Y.

The city council of Morristown, N. J., will shortly advertise for better city lighting, the present system being entirely insufficient.

An electric light company has secured the contract for lighting Cicero, Ill., for five years with electricity. Work will begin at once.

The Badger Illuminating Company of Milwaukee, Wis., has been awarded the city electric light contract for another four years at $110 a year per light.

SEALED PROPOSALS.

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Notice is hereby given that sealed proposals will be received by the City Engineer of the city of Streator, Ill., at the office of the Clerk of said city, up to four o'clock P. M. of Monday, March 21, for paving Main street of said city with brick. Approximate length, 1,896 feet. Estimated quantity of paving, 12,288 square yards. Specifications furnished on application. City reserves the right to reject any or all bids.

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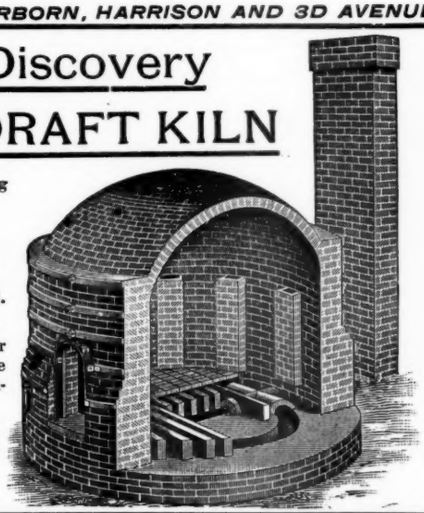

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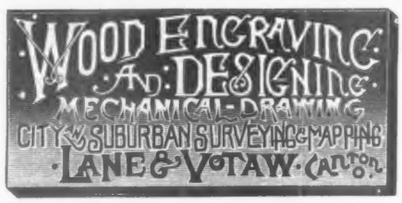

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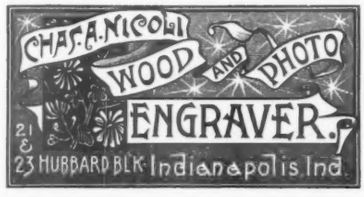

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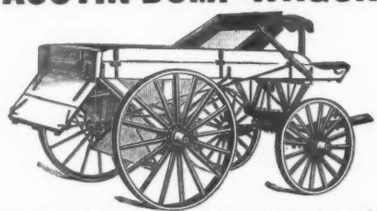

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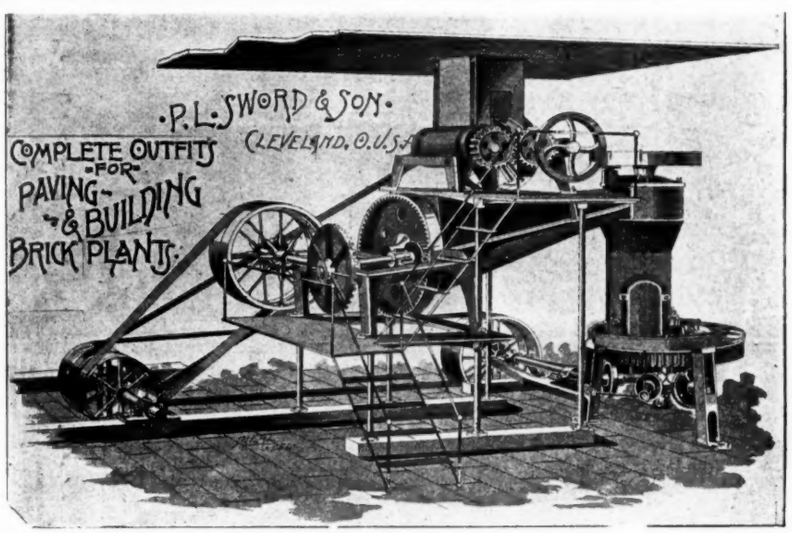

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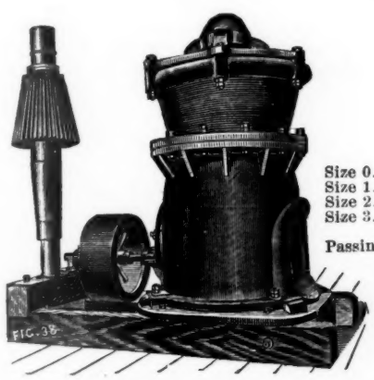

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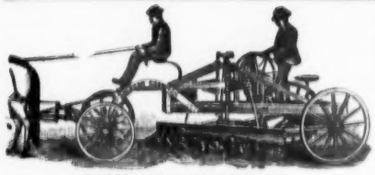

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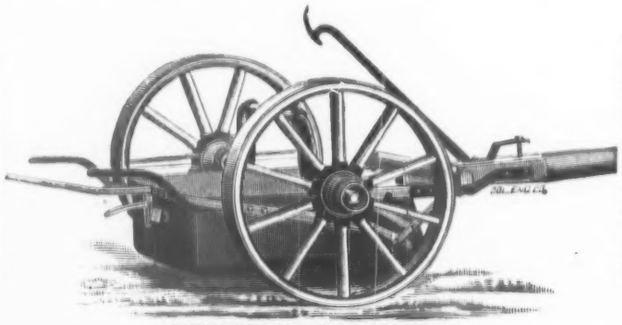

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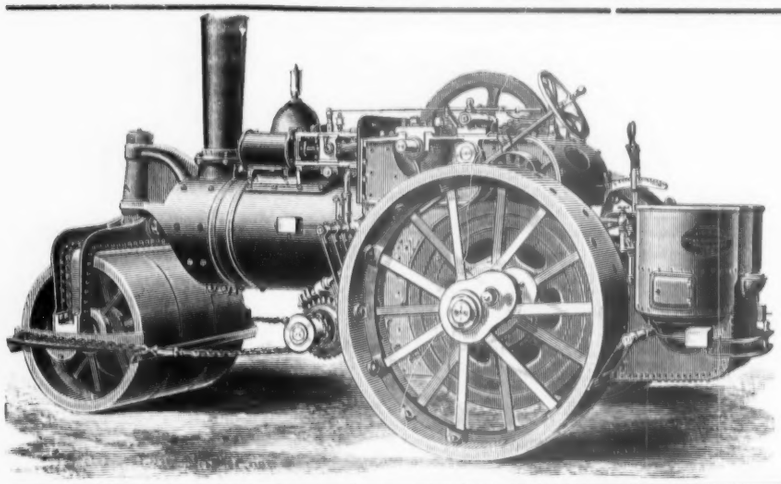

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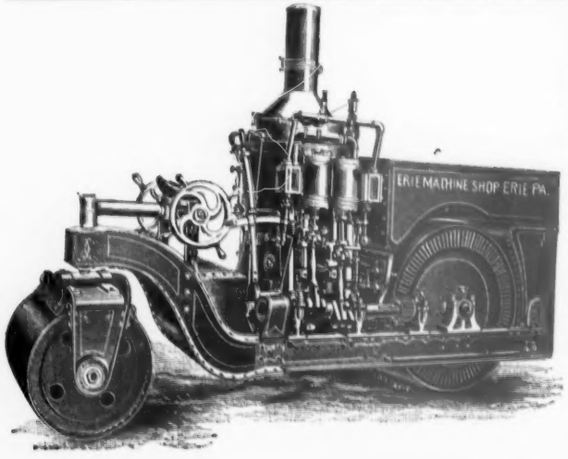

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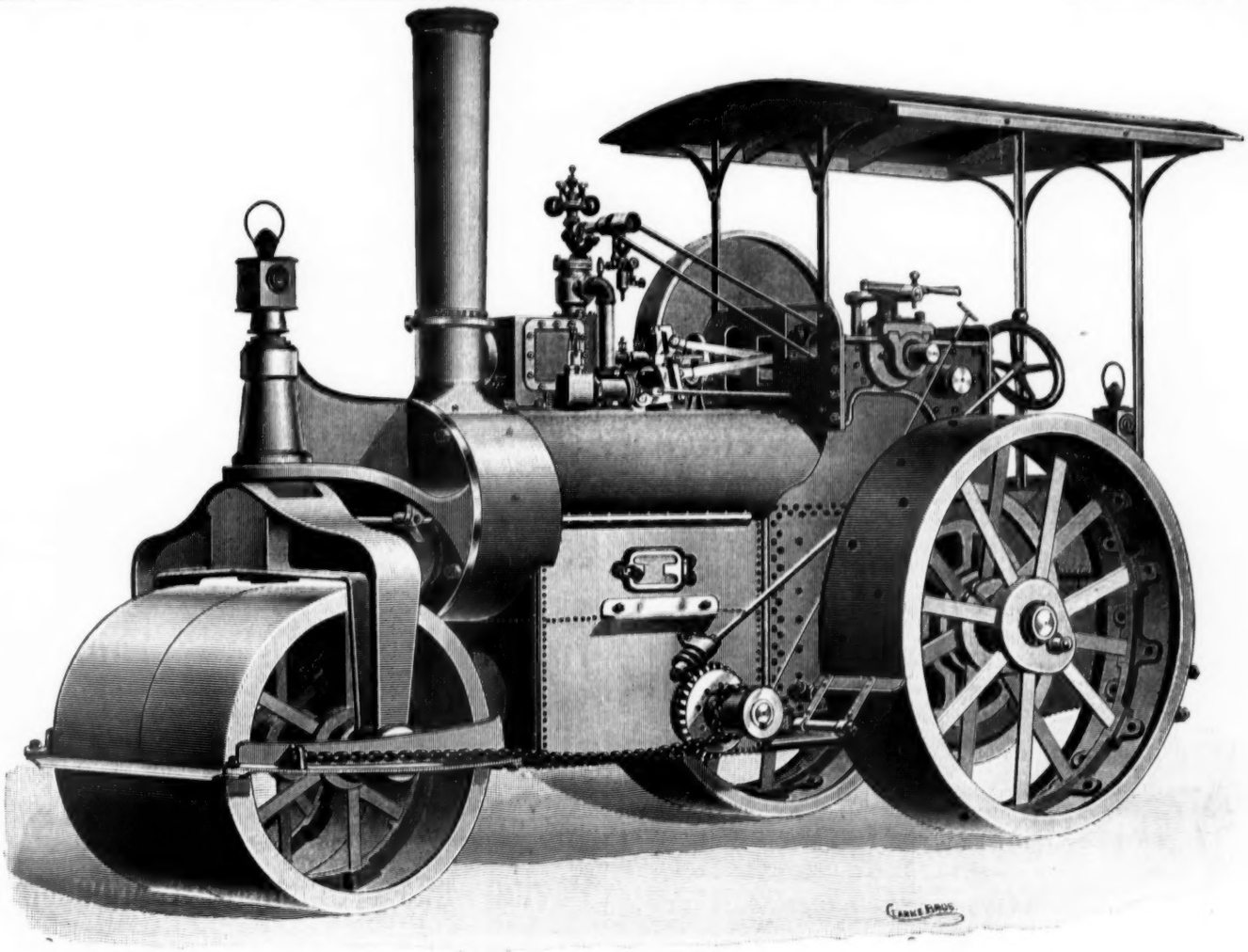

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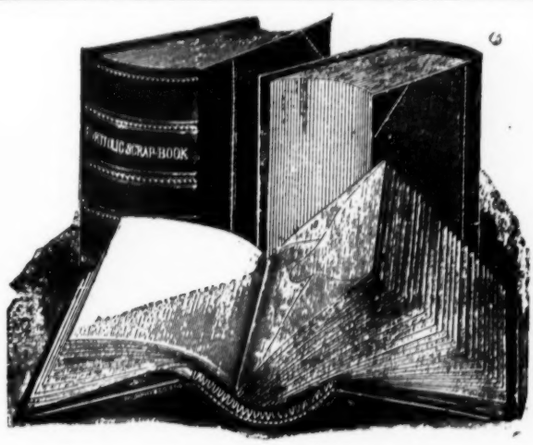

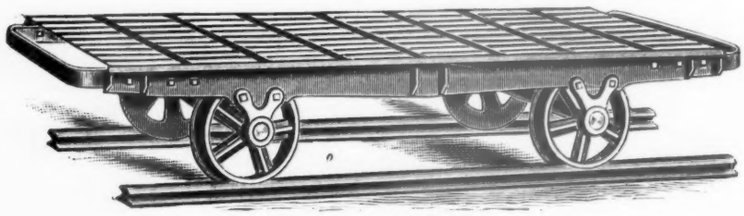

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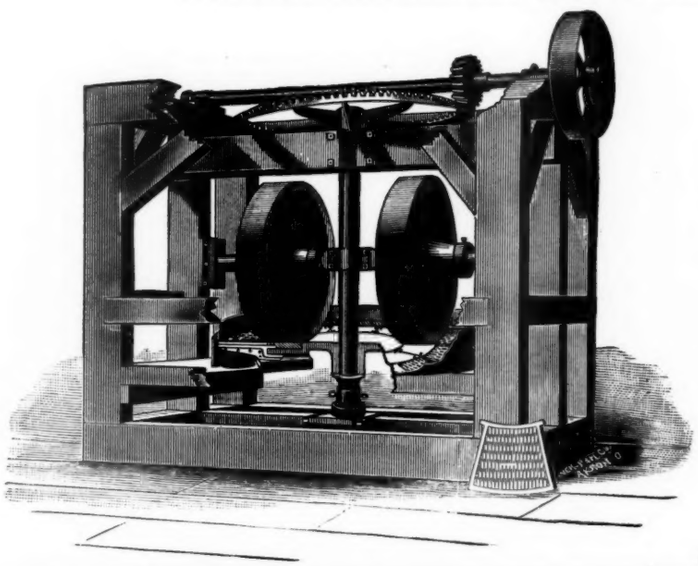

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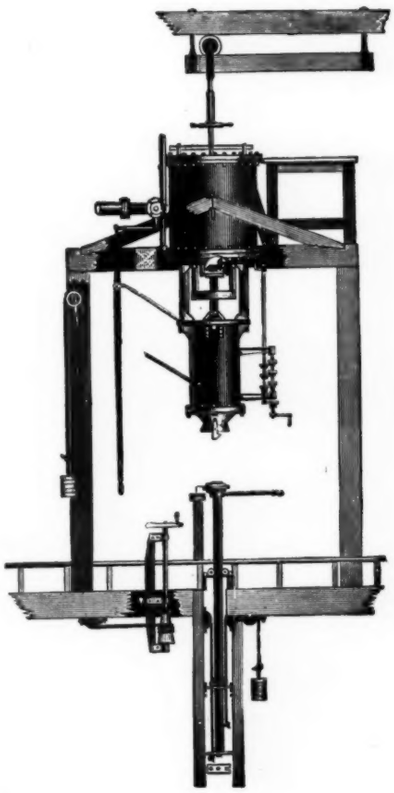

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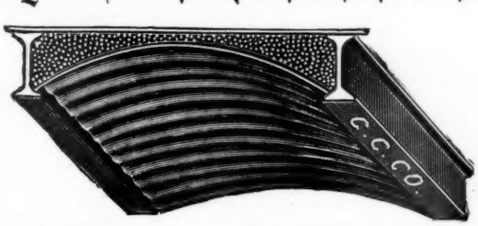

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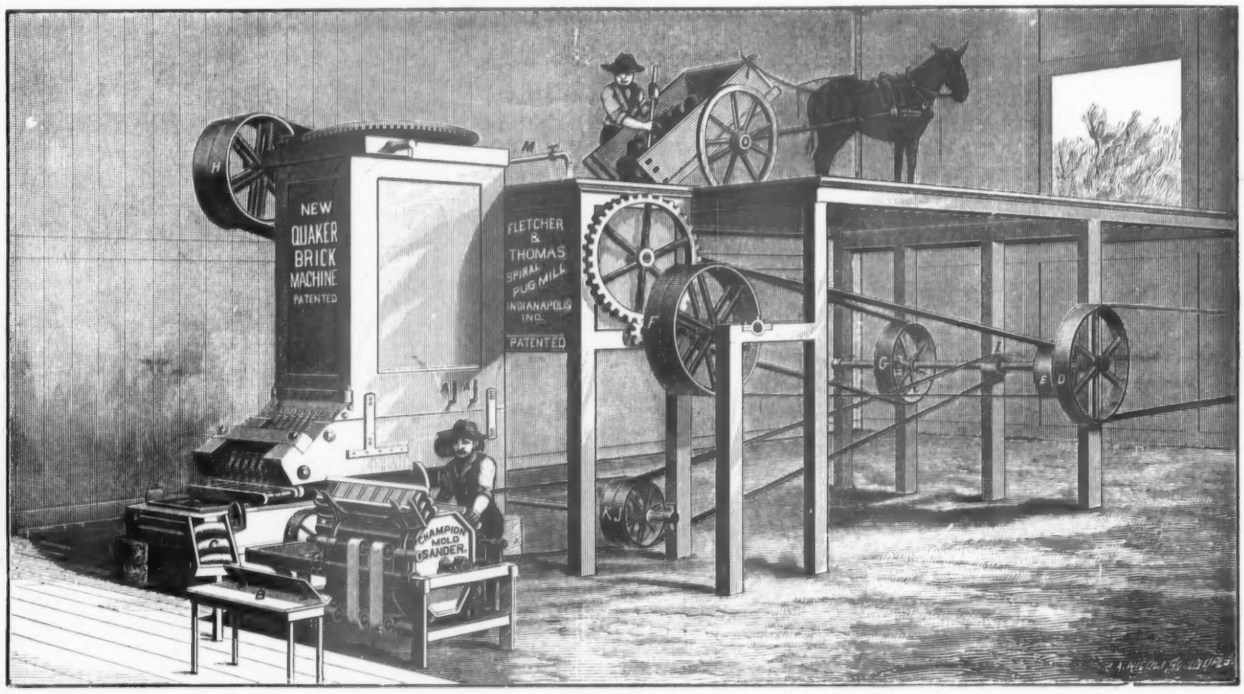

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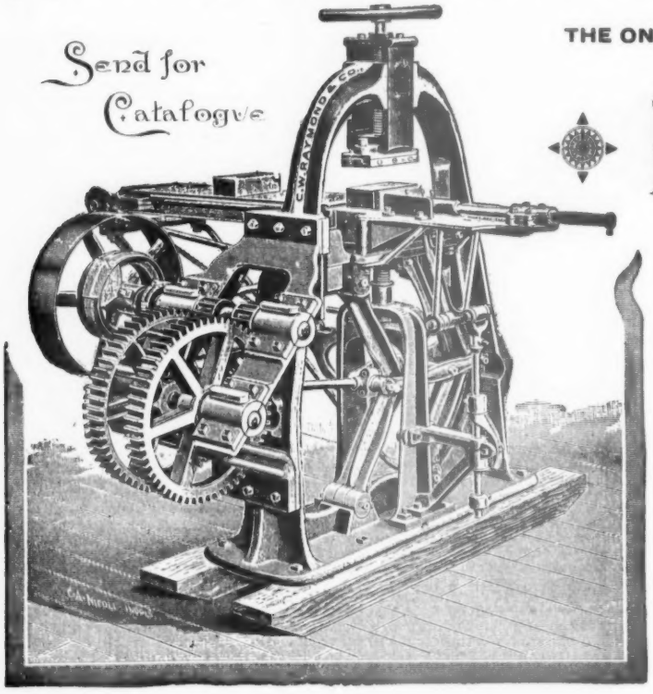

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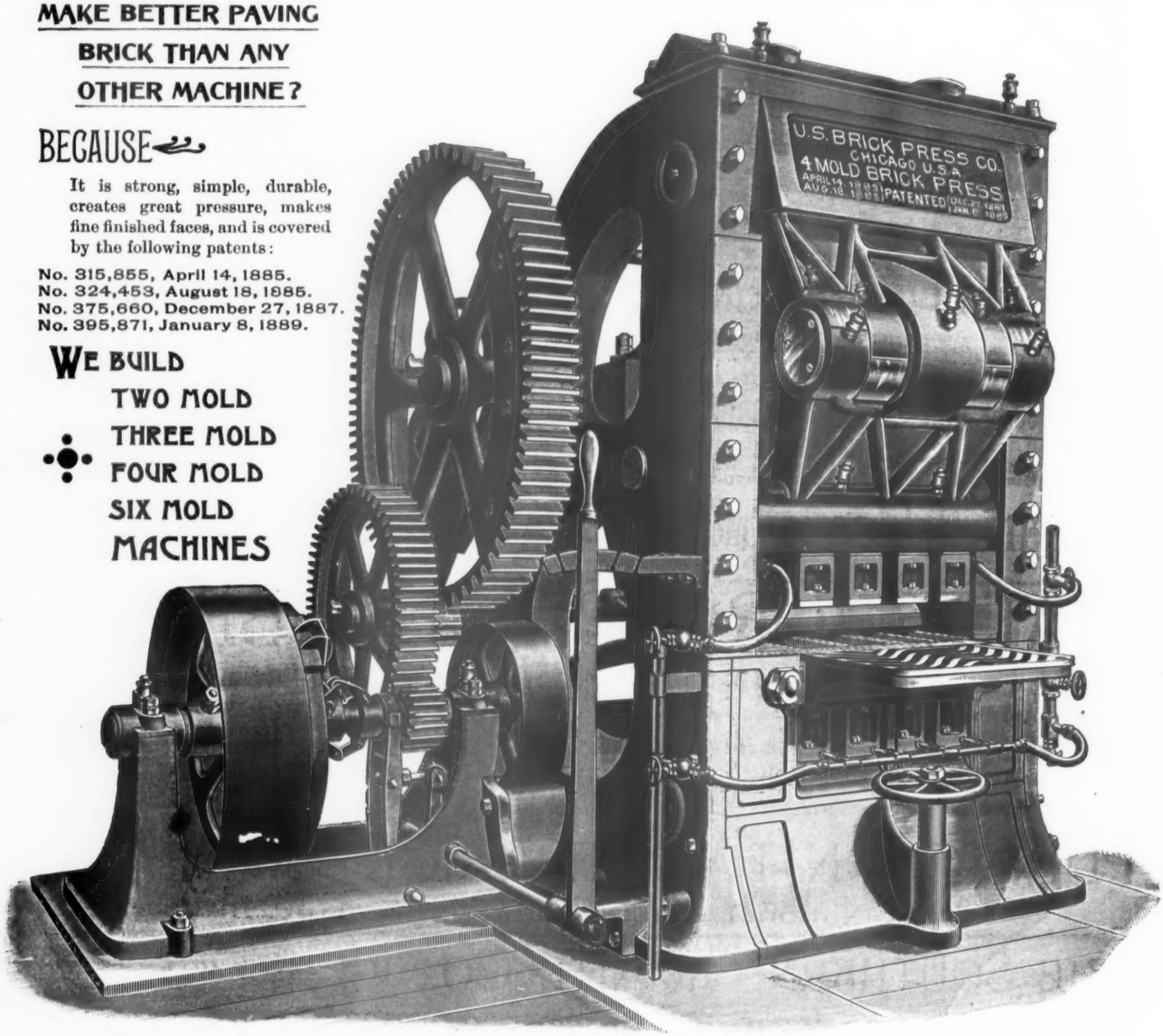

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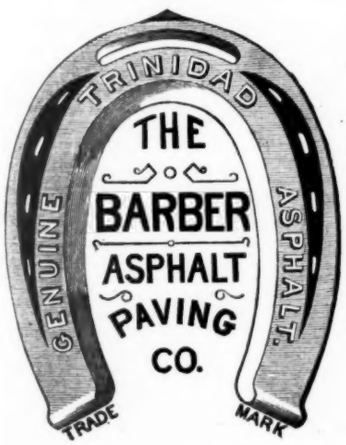

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THE OLDEST AND LARGEST Asphalt Paving Company in the United States; has laid Asphalt pavements in thirty-three cities of the Union, on 857 streets of a length of 442 miles, or an area of 5,915,000 square yards. It has laid more pavement in fourteen years than all other Asphalt Paving Co's in Europe and America Combined have laid in thirty years.

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THE BEST AND CHEAPEST

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Stone, Brick, Wood or Cobblestone, is

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It has been in Use in Columbus, Ohio, for Six Years,

Under the heaviest traffic, without any signs of wear being perceptible. It has been adopted for use hereafter in all block paving.

A secret of success in Block or Brick Paving is the use of interstitial filling that will wear without breaking. Mr. Murphy has discovered the secret. His Grout Filling makes the most durable pavements, as experience with it demonstrates. It is not only infinitely better than coal-tar, but it is forty per cent. cheaper in cost. For full information address

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OF ALL KINDS

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THE BEST PAVING MATERIAL

While Paris, London and Berlin are putting down miles of wood pavement yearly, having proven it the best and most economical, though costing much more there than here, some cities in our own country profiting by their experience are doing the same, as ten miles of our *sapless cylindrical paving blocks* will be laid in Michigan and Indiana during the season of 1891, making an ideal roadway at a low cost. Our second quality blocks make the cheapest crosswalks and warehouse floors and paving for private alleys. Cities desiring the best paving material—dollar for dollar—in the world, should not fail to investigate the merits of our product.

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Cedar Block Pavements

NOISELESS.
DURABLE.
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LAID IN A SCIENTIFIC MANNER AND GUARANTEED BY

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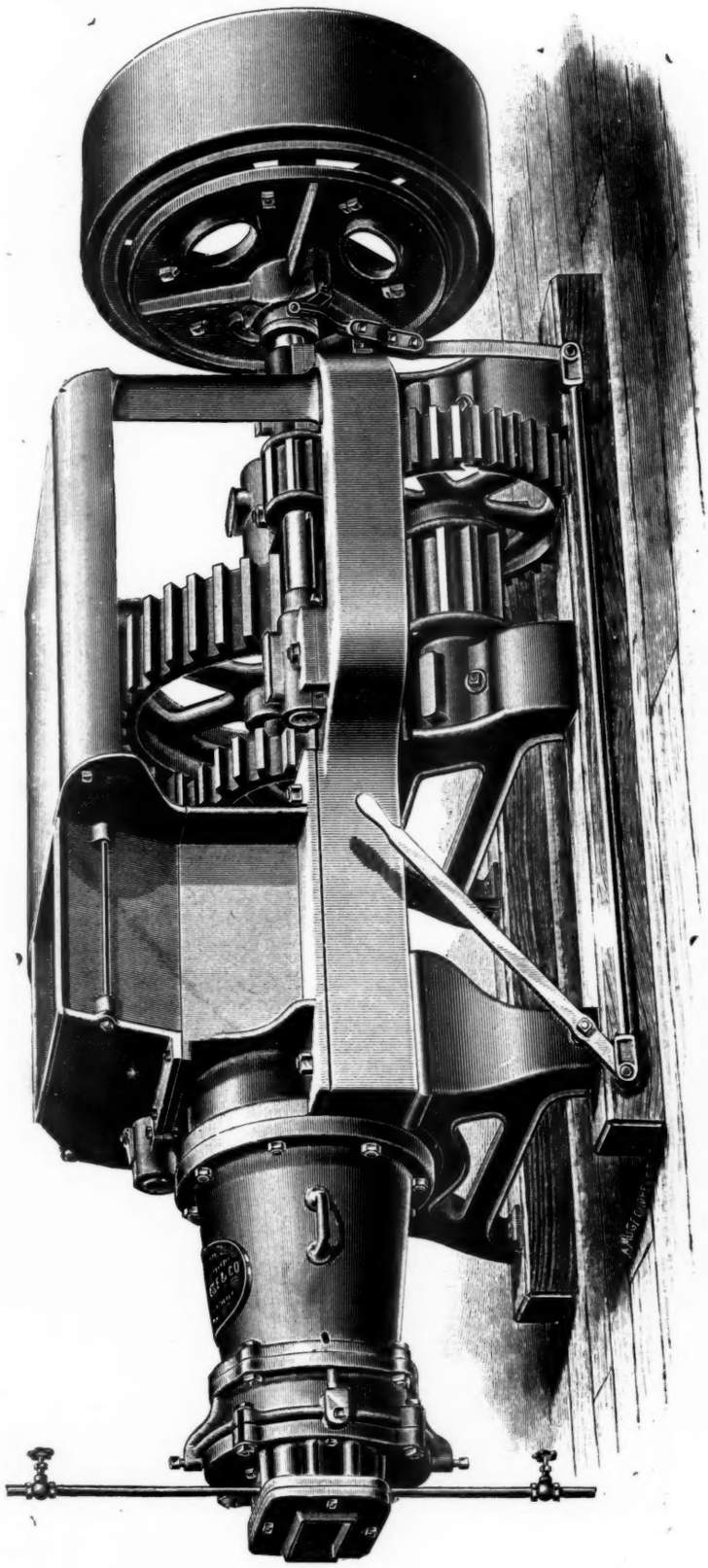
CEDAR BLOCKS FURNISHED IN ANY QUANTITIES.

The New "Ohio" Brick Machine.



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IT HAS special advantages not found in others, and will produce brick of the best quality at the lowest cost.

PARTICULARLY WELL
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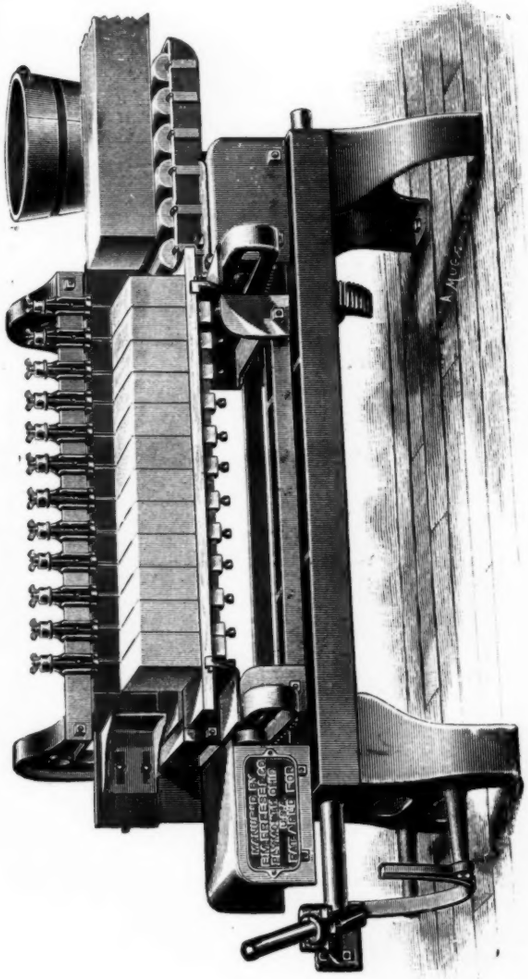

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J. A. BUCKSTAFF, PRESIDENT.

MANUFACTURERS OF

VITRIFIED PAVING BRICK, STOCK BRICK, AND PRESSED BRICK.

ANNUAL CAPACITY, THIRTY MILLION.

Lincoln, Neb., Dec. 15, 1891. 189

J. W. Penfield & Sons,

Willoughby, Ohio.

Dear Sirs,--- We have been using one of your Auger Machines for the past four months, and we are pleased to state that it has given us better results, by far, than we had anticipated, making from forty-five to fifty five thousand brick per day; although the capacity was only guaranteed at thirty thousand. For strength and simplicity of construction it surpasses anything we have ever seen or used.

We consider the Automatic cut-off a marvel of perfection, both for simplicity and durability. An artistic friend, admiring its work, said it was "a thing of beauty", and we add a hope that it will be "a joy forever". At times when everything was working in good order it has cut as high six thousand to sixty three hundred brick per hour, every one perfect, for several hours at a time with practically no waste.

The brick made on this machine are more compact and practicaly free from lamination, and as we are making paving brick exclusively at present, we find that they shrink less, and vitrify more easily than brick made on the machines we formerly used.

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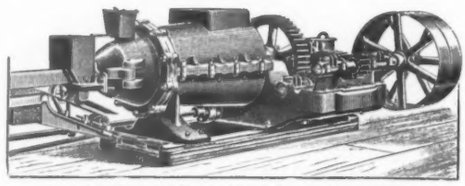
Yours very truly,

Vitrified Paving & Pressed Brick Co.

By J. A. Buckstaff Pres.

(Dictated)

THE PENFIELD



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Are Modern Machines built for Modern use, by Modern Brick Makers.

There is nothing old style or antiquated about them, but they are strictly first-class in every respect.

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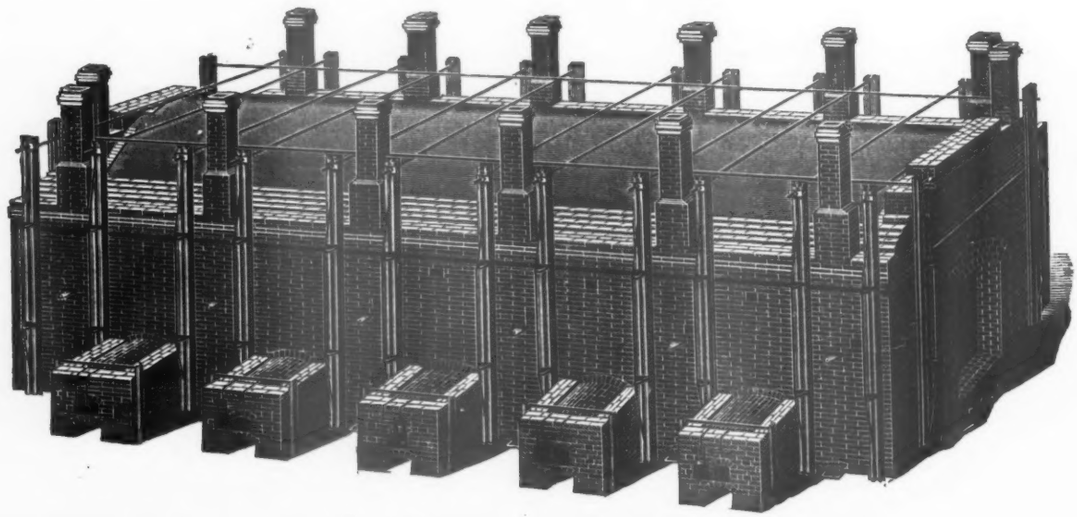

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